THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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THE LOCAL GOVERNMENT RETURN ON MUNICIPAL TRADING.

THE new return on municipal reproductive undertakings is of considerable interest, and should be issued annually, in order that the public may be kept informed of the progress and results of the trading which is competing with private enterprise—usually at the expense of the ratepayers. One of our contemporaries alludes to this return under the heading of "The Municipal Rake's Progress"—an excellent description of the reckless way in which money has been borrowed on the security of the rates for trading purposes, frequently involving heavy losses, besides interfering with the legitimate business of the private trader.

The evidence of the figures, imperfect as in many respects they are, will be a hard nut to crack for the municipal Socialists, who are nervously anticipating the effect upon the public, and are abusing in advance those who may attempt to direct public attention to the facts disclosed in this official return. Upon the important question of ways and means, our municipal rakes will soon be indulging in unpalatable reflections.

In an article we published on October 3rd last, under the heading "The Length of the Tether," we said that "The time is, perhaps, nearer than some suppose, when bankers will hesitate to allow overdrafts, and the local authorities will be seriously embarrassed in consequence," and we urged that the accounts of local authorities should be kept in a form that would show *what security the local authorities have to offer for further loans.*

West Ham, one of the hunting grounds of the municipal trader, has already verified our prediction, for the Public Works Loan Commissioners have refused to lend £27,000 because "*the rates are so high, no less than* 10*s.* 2*d. in the* £," *and it considers the fact of the rates being so high diminishes the value of the security.*

It is not the Industrial Freedom League nor the wicked monopolist companies, that have brought about a state of affairs which the *Municipal Journal* describes as "little short of a catastrophe," and which another journal says may result in fining West Ham a penny rate every year for the next 30 years, significantly adding, "it will make people fight shy of subscribing to further loans!" As a financial paper reminds the public, much of the capital invested in municipal trading was obtained on terms utterly impossible in the present condition of the money market. During the period covered by the return, money was obtained at £2 6s. 7d. per cent. on the average, and consequently the results of the trading would have been much worse, had the capital been raised on the terms now current—say, 3¼ to 3½ per cent.

In spite of this advantage, the surplus shown is only £378,281 on the employment of £100,786,404 now outstanding, that is to say, a little over one-third of 1 per cent., and, curiously enough, about the same result as was shown

under Sir Henry Fowler's former return, which dealt with accounts to March, 1898. But it must not be forgotten that this supposed surplus represents not merely the trading in electricity, but in water, gas, tramways, markets, and other undertakings.

Dealing with electricity supply only, no profits are shown upon an outstanding capital expenditure of £11,192,779, and the loss of £11,707 stated in the return would be considerably increased if depreciation and loss by antiquation of plant had been provided for; 3 per cent., say, for this purpose would amount to £335,783, and very few Corporations make any allowance at all.

The case of West Ham may be considered as a catastrophe when the purpose for which the loan of £27,000 was required is taken into account. It is the education of the children that is in question, for the money was wanted as a first instalment towards the cost of a school, which is absolutely necessary and must be provided, in the absence of a loan, by a further increase in the rates and consequent reduction in the value of the securities. The losses on the electricity undertaking at West Ham have been very heavy, and the whole of their trading shows a loss according to the return of £2,512, but this amount is far from representing the actual losses sustained in the electricity accounts.

In dealing with the return, which the *Municipal Journal* considers to be so satisfactory as to set at rest all exaggerated statements about municipal trading resulting in loss, our contemporary encourages the ratepayers by saying that the net surplus profit of £656,376 "no doubt went in relief of rates," but subsequently finds that after deducting losses there remained a net profit of only £378,281; so that according to our municipal traders' methods of calculation £656,376 went to relieve rates out of a net profit of £378,281!

As the facts disclosed in this return are grasped by the ratepayers, there will be less inclination to support local authorities in competing with private enterprise in trading ventures about which they know nothing; the public will limit their representatives to the business appertaining to the management of the ordinary affairs of the town. It is a sign of the times that so many local authorities are seeking for companies to take over their provisional orders and relieve them of their responsibilities, and in other cases a great deal of opposition is offered to the granting of loans for such undertakings.

Misunderstandings on the Finchley Overhead Wires Case.

We frequently find ourselves in disagreement with our contemporary, the *Electrical Engineer*, on questions of public policy, and we are therefore all the more pleased to find the opinion which we expressed on the Finchley case in last week's issue, supported in the corresponding issue of our contemporary; but while we are thus in agreement in finding satisfaction in the decision of the Court of Appeal, we must point out that our contemporary has missed the whole point of the case, and has stated wrongly what the effect of the decision is. As we stated last week, the point was that the Finchley Electric Light Company is supplying current *without* statutory authority. Yet the *Electrical Engineer* sums up the position thus:—"The more recent decision of the Court of Appeal "*i.e.*, the decision in the Finchley case," however, will set the matter at rest once and for all, and will effectually prevent those local authorities who embark on municipal enterprise from taking unfair advantage of private companies, *who may be authorised to conduct a rival undertaking* within the same area." Of course, as we have pointed out, if the Finchley Company had been an authorised one, it would have been expressly forbidden by the Electric Lighting Acts to put overhead wires across a road or street without the consent of the Urban District Council, so that this case could not have arisen. It was purely because it was an *unauthorised* company, acting without a provisional order, that the company could erect overhead wires, being thus in a better position in this respect than an authorised company. It is most important that this point should be properly realised, and as we believe the misapprehension is by no means confined to our contemporary, we have thought it right to refer to an error which otherwise might have been allowed to pass unnoticed.

The Energy of Magnetisation.

In a paper read before the Royal Society on January 22nd, Dr. Larmor, secretary Royal Society, points out that there appears to be still some uncertainty as to the principles on which the energy of magnetised iron is to be estimated, and the extent to which that energy is electro-dynamically effective. The author takes as the simplest example a current flowing in a coil wound on a narrow iron ring-core. The energy in this case is made up of two parts, an electro-dynamic part and a magnetic part. The former is mechanically available. The question has been raised by Lord Rayleigh, as to whether the latter part has any considerable mechanical effectiveness. This question can only arise when it belongs in part to *permanent* magnetism whose ultimate annulment can induce a current. The conclusion reached by Lord Rayleigh is that it cannot be annulled quickly enough, when the ring carries a coil, to develop any considerable available electric energy by induction. Dr. Larmor gives a representation of the mechanical *rôle* of this purely magnetic energy by considering as the analogy of the currents a branching system or network of pipes carrying liquids, in one of which pipes a turbine is placed, to be driven by the stream, which is supposed to be an alternating one. The flow will be directed more fully into this particular pipe, and higher pressure will also be obtained, as in the hydraulic ram, if it communicates at the side with an expansible reservoir, into which the liquid can readily force its way, to be expelled again by the elasticity of the walls when the stream begins to set in the reverse direction. The increase of kinetic pressure on the turbine roughly represents the electromotive pressure on a motor due to the increased magnetic flux, and the energy spent in expanding the reservoir as it fills up represents the energy of magnetisation of the iron. If things were perfectly reversible in the reservoir, that is, if the iron were perfectly soft, the latter energy would rise and fall concomitantly with the alternations of pressure on the motor, but otherwise it might contribute nothing to the energy driving the motor, and this energy must be introduced into the system from an extraneous source. But if there are frictional resistances involved in filling the reservoir, the operations will not be perfectly reversible, and mechanical energy will be lost in it by conversion into heat; and, moreover, on account of the phase of its changes getting out of step, still more by permanent delays such as are classed under hysteresis, it will operate less efficiently in directing the stream of energy towards the turbine. Both these statements apply by analogy to the iron in a magnetic circuit.

An example is provided by the ring above mentioned. Suppose that when the current has ceased in the coil, the core retains permanent magnetism. This corresponds to the reservoir becoming temporarily choked, so that it retains its contents after the pressure which drove the liquid into the reservoir has been removed. The question arises whether this retained energy is available for mechanical work. The present aspect of the matter leads to the

same conclusion as Lord Rayleigh's, that it will not be available to any considerable extent unless its pressure in the reservoir is considerable, that is, in the magnetic case, unless the iron is not very receptive of magnetisation.

After an elaborate mathematical investigation, Dr. Larmor arrives at the following conclusions:—

1. In an electro-dynamic field there exists the usual specification of electro-kinetic energy, but also *in addition* the energy of magnetisation of magnetic material.

2. This energy of magnetisation appears as made up of a part given by the ordinary formula, which (when paramagnetic) is derived from thermal sources, and so in the absence of hysteresis has the limited mechanical availability of thermal energy; together with a local part which is to some extent thus available, but is also in part permanent intrinsic energy of the molecules, regarded temporarily as magnetic energy.

3. The law of Curie, that the susceptibility of weak paramagnetic substances is inversely proportional to the absolute temperature, is involved in these statements.

4. The extent of the direct (non-thermal) availability of *retained* magnetism can be inferred only by empirical procedure, for example in general features by inspection of the hysteresis diagram, as pointed out by Lord Rayleigh.

Automatic Railway Signalling.

Our criticisms of the Miller system of automatic signalling, based upon the descriptive matter furnished to us by the promoters on the occasion of our visit to the demonstration at Woodhead, have elicited further information, which somewhat modifies our views. The essential facts added to our knowledge are :—(1) That, apart from the red and white lamp signals, there is an independent semaphore signal in the cab of the locomotive, operated by current derived from the track alone, and thus unaffected by any irregularity or injury which may disable the lamps, the dynamo, or their connections. (2) That, with separate up and down tracks, there is no line wire whatever, the signalling being effected wholly by way of the rails. This is, we believe, a new feature in automatic railway signalling, and has the great recommendation that specially insulated conductors, with all their liability to breakdown and cost of upkeep, are entirely dispensed with. This does not apply to a single-track system, which requires one line wire. In passing, we may note that the reply to our query as to the length of the block sections on a graded single track has been answered, to the effect that the blocks in one direction can be made shorter than in the other. (3) That, in addition to the signals in the driver's cab, signals are provided at the side of the line near junctions, which automatically indicate the state of the particular branch line for which the points are open, and blocking it if it is fouled by vehicles on the other branch.

The promoters freely admit that, under the existing regulations, their system can only be installed as an auxiliary to the semaphore signals at the side of the track. However, as we pointed out, the Board of Trade is not opposed to progress, and the promoters anticipate that when their system has demonstrated its reliability under working conditions, the Board will relax its rules, and will permit the manual signals to be dispensed with. Obviously, the essential condition is this proof of reliability. We need not dwell upon the fact that one grave accident attributable, rightly or wrongly, to the substitution of an automatic system for manual signalling, will throw back the introduction of improved methods for many years; we trust, therefore, that every care will be taken to avoid such a catastrophe by exercising the utmost forethought and the most critical inspection in carrying out any such installation on a working scale. The result we leave to the future; if a system of automatic signalling can be inaugurated and successfully maintained in this country, the Miller system is at least as likely to attain that object as any other system.

THE EDISON BATTERY FOR AUTOMOBILES.

By W. HIBBERT.

The New York papers for the last week in January contain some account of an automobile show, and specially mention an exhibit of Mr. Edison's new cell, adapted for automobiles. There are 38 complete cells, each 14 in. high × 5½ × 3½, weighing 18 lbs. Their capacity is given as 200 watt-hours. Mr. Edison appears to have spoken about the cells on the day of opening, and as his remarks indicate his attitude towards the respective claims of the alkaline and acid cells, it may be worth while to quote them.

Mr. Edison is credited with the following:—

"The experimenting with the new battery has all been done, and the only thing that remains is to adapt them to the use of the public.

"These batteries are for public use and not for experts, and before they are put on the market I intend that they shall be adapted to the use of the most ignorant and most careless persons. The electric vehicles now in use require expert care in charging and management. That is why they are so largely used for commercial purposes. In pleasure vehicles we have to contend with absolute neglect and abuse, and the better they work the more they are neglected. It is only when they refuse to work that they receive attention. Now, with the new batteries there will be no complaints from users to which we will have to reply: 'You ought to have done this,' or 'You ought to have done that.' They don't have to do anything to them at all, and they will run all right. We don't even want them to put in the solution. We will do that ourselves, and seal it. And there will be no waste or loss.

"They can be charged as quickly as anyone desires; in fact, they will meet every condition required. A most valuable feature of the new cells will be their rapid rate of discharge, which will give a very large amount of power in any emergency; this will be a particularly great advantage to hill climbing in bad weather or on a poor road. The cost of charging, of course, is a small matter. The cost of running an ordinary electric vehicle, including the services of a man, a boy, repairs, &c., is about $4 a day, of which the cost of charging is only about 23 cents. Probably only a few people realise how small a proportion of the cost of electric propulsion is the item of power. On a trolley road, for example, it is only about 7 per cent. of the entire cost.

"In our experiments with pleasure automobiles we have used an electric runabout of a well-known type, made in Cleveland, Ohio, and have found that 25 cells, weighing 460 lbs., will run the vehicle over fairly level macadamised roads, such as are found in this part of New Jersey, with a load of one person 100 miles to a standstill. Of course, on asphalt, it would do much better, so that these figures might be taken for ordinary city use as well. We have run 3,000 miles over the Belgian blocks between the car tracks with one set of batteries, and at the rate of 12 miles per hour, and after that test the batteries have seemed better than at the start. No deterioration could be observed, even under the microscope."

Asked concerning the cost of the new cells, as compared with the ordinary type, Mr. Edison said: "They are far cheaper, even now, on account of being practically indestructible. At present they will cost about 33 per cent. more than the ordinary type, but this cost will be largely reduced. It is due almost entirely to the high cost of the material. For example, there are 22 operations in the making of the cover alone, and yet the cost is only 1·8 cents. The steel we use comes from Germany, and we not only have to pay two prices for it there, but a duty of 40 per cent. on it in addition. The ore from which the nickel oxide is obtained comes from New Caledonia, but the oxide is made in this country by the Nickel Trust. Every item of cost will be reduced when we get to turning them out in quantities."

Mr. Edison is making arrangements for the use of his cells by several large retail dry goods houses. He proposes to work their most difficult routes, where ordinary electric vehicles are now unavailable for the purpose, and horses are still used. He guarantees a run of 40 miles per charge, against 25, the present average of the lead type of cell.

"The cells will be in plenty of time for the new season, I will promise you," were Mr. Edison's final words.

Five definite grounds of superiority are here claimed: (*a*) reliability under all kinds of treatment; (*b*) long life; (*c*) rapid charge and discharge; (*d*) freedom from local action; (*e*) lower weight per unit of work.

If these can be substantiated, all electrical engineers (except the unfortunate makers of lead cells) will have reason to rejoice. The contest will range round (*a*), (*b*) and (*c*). (*a*) will not be decided till the public at large has had the chance of showing what it can do.

Long life may be assured, but experience must decide, and we must wait for records, not of a run of 3,000 miles, but of 5,000 and 10,000, spread over a fair time; 3,000 miles' run may mean no more than 30 or 40 chargings.

In this connection one must notice the statement that the cells, after 3,000 miles, "seemed better than at the start." This is reminiscent of a certain stage in the life of ordinary lead cells, though we hope it arises from a less injurious cause.

In respect of weight, the capacity is given as 11·2 watt-hours per pound. In Dr. Kennelly's first paper two years ago, the figure was 14 watt-hours per pound. This may mean that it has proved desirable to strengthen the parts. But, in any case, we may welcome any improvement that Mr. Edison can give us.

THE DEVELOPMENT OF MOTIVE POWER SUPPLY.

On the occasion of the inaugural meeting of the Leeds Local Section of the Institution of Electrical Engineers, which was held at the Yorkshire College, Leeds, on 19th inst., a paper of considerable interest was read by Mr. R. A. Chattock (city electrical engineer, Bradford), who dealt with the question of motive power supply from central stations.

The paper forms a record of the development of motive power supply, incidentally drawing attention to the hire system and methods of charging for energy for motors at Bradford.

After referring to the advantages, common to the consumer and the supply authority, of an increased load factor, Mr. Chattock gives the following information as to what has been done by the Bradford Corporation in regard to motive power.

The supply is on the direct-current system, the voltage being 230 or 460. The first motor was connected to the system in 1891, but little progress was made until 1897, when the system of hiring out motors was introduced, together with a reduction in the price of energy to 2½d. per unit.

The percentage of energy sold for motive power to the total output was only 6·7 per cent. in 1896, increasing, however, to 49·25 per cent. in 1902; during the interval the charges were reduced to their present level—viz., 2d. for intermittent and 1d. for continuous use.

During these years the lighting consumers benefited considerably, as, owing to the improved load factor and the increase in the output generally, a large reduction was made in the price per unit, from 6d. in 1892, to 4½d. less 2½ per cent. discount, and a free supply of incandescent lamps, in 1899. The Corporation anticipates further reducing this figure in the near future.

The lecturer then briefly touched on the calculation of the cost generating a motive power supply—mentioning that a very slight increase in the plant is required to meet emergencies, such as fogs, and the heavy winter load—lasting for some half-hour a day during six weeks.

It is found that in the same way the existing mains network suffices for the majority of the motive power consumers. In the case of large extensions becoming necessary, the estimated revenue from energy should equal a pre-arranged percentage (10 per cent. having proved satisfactory in Bradford) on the capital outlay—otherwise the application should be rejected.

Turning to the considerations affecting the price to be charged, the present methods are stated to answer fairly well, although open to several objections, as, for instance, in the case of some consumers who, though using their motors intermittently, consume a much greater number of units per horse-power installed than others who have their motors running continuously; also it is very difficult to decide whether a motor is being used intermittently or continuously. Then again, the maximum demand system of charging is not so applicable to motor supply as it is to lighting, owing to the fluctuating nature of a motor load and the liability to sudden heavy overloads; and the lecturer came to the conclusion that the best method of charging is to base a sliding scale charge per unit upon the number of units used per horse-power installed per half year. Such charges might be graduated, as, for example, 1d., 1½d., 2d. and 2½d.

From local experience it is found that, compared with a gas engine using gas at 2s. 3d. per 1,000 cb. ft., the cost of running a motor at 1d. per unit is usually considerably less, though, in some cases, it equals half, and in others approximately the same cost, the latter being the case only when the gas engine is employed under most economical load conditions. Where the load is subject to great fluctuations, as in the case of cranes and hoists, the motor at 2d. per unit shows a great saving over the gas engine, due to the facility with which it can be started and stopped.

In discussing the question of rental, it is suggested that any profit required shall be obtained from the sale of energy. The rental should include the following items:—Interest upon capital cost of motors and other apparatus, inspection of motors periodically, maintenance of motors due to fair wear and tear, and depreciation of motors. In the City of Bradford, for the year 1902, the cost of inspection and maintenance of the 2,996 H.P. of motors on hire amounted to £1,723, and it is suggested that an amount of 15 per cent. on the capital outlay is sufficient for the above purposes, allowing a margin for depreciation.

The paper covers ground which is fairly well known to electrical engineers, but as a record of the experience gained in one of our most enterprising municipal electrical undertakings—Bradford, it may be recalled, was the first Corporation to put this system into operation—it has considerable value for those who contemplate establishing a motor-hiring department.

The following table, supplied by Mr. Chattock, shows the progress of motive-power supply at Bradford and the resultant improvement in load factor:—

Year.	Motors on the supply at Dec. 31st.			Units sold for motive power.	Total units sold to private consumers.	Percentage of motor units to total units.	Price charged per unit for motive power.	Average price per unit obtained for motive power.	Load factor, excluding traction.
	On hire.	Not on hire.	B.H.P.						
1890	—	—	—	—	108,102	—	—	—	No record
1891	—	1	3	—	239,361	—	—	—	"
1892	—	6	20	3,222	365,854	·88	4½d.	4·5d.	"
1893	—	26	110	19,346	480,494	4·02	4½d.	4·5d.	3·13%
1894	—	30	128	28,884	554,633	5·21	4½d.	4·5d.	5·47%
1895	—	35	143	35,919	673,699	5·33	3½d.	3·5d.	6·40%
1896	7	58	244	54,972	813,623	6·76	3½d.	3·5d.	8·93%
1897	48	70	414	117,176	993,588	11·80	2½d.	2·5d.	10·14%
1898	124	103	832	205,243	1,217,287	16·86	2½d. to 1d.	2·18d.	10.19%
1899	259	152	1,636	463,630	1,797,848	25·79	2d. and 1d.	1·50d.	10·21%
1900	405	204	2,622	933,455	2,471,162	37·77	2d. and 1d.	1·22d.	12·40%
1901	525	229	3,460	1,297,120	3,012,158	43·06	2d. and 1d.	1·20d.	11·74%
*1902	641	272	4,398	1,899,873	3,857,757	49·25	2d. and 1d.	1·17d.	13·78%

* The figures for 1902 are approximately correct.

CORRESPONDENCE.

East Barnet Valley.

In your last issue appeared a note under the above heading, which forms a very fair *résumé* of some evidence given at the inquiry in favour of the North Metropolitan Power Distribution Co. Without troubling you with details, I desire to say that the arguments in favour of the Council introducing the electric light are convincing, and that if the L.G.B. properly appreciates how the opposition was fomented by interested parties, and the signatures to the memorial obtained by gross misrepresentations, there is little doubt but that the loan will be granted. There is a strong feeling on the part of the Council against allowing their electric lighting powers to be absorbed by the vast group of companies with

which the North Metropolitan Power Distribution Co. is associated.

It is a very general opinion that the efforts of those interested in the group would be better employed in developing the undertakings they have secured, rather than in continually launching out in fresh directions.

I may perhaps be permitted to add that my evidence, so far as it was alluded to in the note, has not been correctly reported.

W. P. Adams.

London, E.C., *February 18th*, 1903.

Fuel Value of Town Refuse.

We are glad to see in your issue of January 23rd that Mr. Frank Broadbent has taken up the challenge thrown down in another publication, and has justified up to the hilt his own previous articles. While there are other arguments both for and against the combination of refuse destructors with electric lighting schemes, it is a little late in the day for anyone to attempt to show that refuse is not capable of giving a constant supply of high-pressure steam, when burnt in a good modern destructor, properly and regularly worked.

The annexed table, showing the evaporation obtained on eight Horsfall destructors, situated in various parts of the country, where the fuel value of the refuse may be supposed to vary considerably, shows that a good evaporation can be relied upon in practically any part of England.

Plant.	Refuse burnt per 24 hours.	Horse-power from refuse.	Evaporation per pound of refuse.
1. Pembroke (Co. Dublin) Electricity Works	18 tons.	84 I.H.P.	1·21 lbs.
2. Stockton-on-Tees	23 „	109 „	1·22 „
3. Salisbury Sewage Works ...	25 „	115 „	1·23 „
4. West Hartlepool Electricity Works	55 „	265 „	1·25 „
5. Fulham Electricity Works, London, S.W.	125 „	500 „	1·3 „
6. Accrington Electricity Works	57½ „	308 „	1·39 „
7. Huddersfield Sewage Works	32 „	189 „	1·42 „
8 Beckenham Electricity Works	32½ „	191 „	1·512 „

The fuel value of North Country refuse is generally supposed to be superior on account of the quantity of cinders it contains. Up to a certain point this is true, but in these same North Country towns there are frequently a number of the old-fashioned wet ashpits, or the even more objectionable privy middens, the refuse from which being very wet and foul, brings down the calorific value considerably.

You will see, therefore, that one can with modern appliances absolutely guarantee an evaporation of at least 1 lb. of water per pound of refuse in almost any English town, and if this can be done with the ordinary refuse and the ordinary staff for a month, a week, or even 24 hours, there would appear to be no reason why it cannot be done for an indefinite period of time.

We would point out, however, that in striving after high evaporations, the cost of labour is often neglected, and the value of an extra 10 per cent. of steam is considerably discounted when it is obtained at an increased cost of 30 or 50 per cent. for labour.

We should recommend any of your readers who may be investigating this question, not to omit to ascertain the cost of labour per ton, in each case.

The Horsfall Destructor Co., Ltd.
F. L. Watson.

Leeds, *February 13th*, 1903.

Dry Batteries.

I have lately come across a large number of glass cells imported from the Continent and now being sold in various parts of the country as dry batteries. These apparently are larger, and presumably of much more power than an ordinary E.C.C. or Obach cell, but when tested are found not to give out one-third of the power of either. I have cut open three or four of these glass cells, differing in appearance, and found in each only a very small battery, the remainder of the cell being filled with sawdust and resin or pitch. I think this ought to be exposed for the benefit of the public, as these cells are got up so as to appear to be a *bonâ fide* large battery.

Electron.

The Wiring of Buildings.

Referring to the correspondence which has been recently taking place in your columns regarding the wiring of buildings, and particularly to the letter of "Robert" in your issue of the 20th inst., may I be permitted to draw his and other correspondents' attention to our advertisement in your paper, which points out that we undertake the kind of work they wish to see done. I may mention that we have a large and increasing business, in the inspection and testing of wiring and electrical installations generally, and we shall be glad to be placed in communication with your correspondent "Robert."

I. F. J. Crosland,
Chief Engineer, Vulcan Boiler and General Insurance Co., Ltd.

Manchester, *February 21st*, 1903.

I have read with much interest your correspondence on the above subject, especially with regard to inspection, wiring, testing, &c. The supply authority in the town to which I refer issue a set of wiring rules for the use of contractors. An insurance company in the same town accept a risk if the work passes the test of the Corporation engineer. Now, may I briefly summarise what this inspection (*sic*) amounts to :—

Scene—Basement of business premises.

Enter assistant from electricity works: he is met by foreman.

A.: "Everything ready, I suppose?"

F.: "Yes. Would you care to have a look over the job?"

A.: "May as well."

Proceeds on a round of so-called inspection; *might* take the cover off a switch, or try and pull down a piece of casing, but "inspection" usually ends here.

A test is then made, and if the insulation resistance reaches the minimum required for the particular number of lights, the job is connected.

All the real faults, such as too many lamps on branch circuits, sizes of wire, type of accessories used, and, above all, hidden work, are entirely disregarded.

Now, I do not suggest that it is the business of the supply authority to really inspect installations during the progress of work, but I do certainly consider that if the authority issue rules for wiring, they should exercise their power, and refuse to connect installations unless these are adhered to.

The great fault I have to complain of is, that the authority (whose supply is one of 220 volts) have passed installations fitted entirely with accessories of old design, originally made for 50 or 100 volts. These, of course, are put in by an unscrupulous contractor, much to the disadvantage of the consumer, with the following result:—

The installation, after a series of breakdowns, has to be gradually transformed by constant repairs, this being a source of annoyance to the owner, and a detriment to electric lighting in general.

I am quoting from actual experience.

I firmly believe the best way of dealing with the question is for the insurance companies, either jointly or separately, to employ a really *competent electrical* inspector, who should have power to visit installations during the progress of the work, and make suggestions for any improvement really necessary; if these were not carried out, the risk would not be accepted, and the facts should be made known to all the insurance companies of repute. The inspector must be a thoroughly practical, well-paid official (I say *well-paid* advisedly), preferably one who has had to work with his hands as well as his head. It is absolutely useless pushing a man, or youth, into this position, simply because he happens to be the son or other relative of a chairman or director of the insurance company.

E

It is time this sort of thing was put a stop to. When a competent man comes to inspect a job, he will be welcomed by a conscientious contractor, as Mantby Hill says, but there is certainly no reason why a contractor should be expected to pay anything towards cost of inspection, as this is a matter for the insurance company or consumer.

Until some such method as the above becomes general, we shall have to put up with jerry wiring and its results.

Fair and Square.

I have to thank your numerous correspondents for their interesting replies to my letter.

We apparently all agree that there is such a thing as atmospheric leakage, on new jobs at any rate, and naturally I agree with some of "Inspector's" remarks in his letter of this week's issue, and I would very much like to get his opinion on the following job, which was tested and passed the other day. For a new villa of three flats and 30 lights in all, we used about 5 coils of 600 meg. wire, which was drawn into tubes and draw-in boxes. After all plaster work was finished, and the floors were laid down before fixing any switches or fittings, we got a test on the wire of 50 megs. between wires, 16 megs. on the negative, and 12 megs. on the positive side. After all fittings were on, ready for the Corporation test, we followed your correspondent "Another Foreman's" advice to well varnish all wood work in connection with fittings, and even the backs of ceiling roses and switches. We got a test of 3—5 megs. between wires, 3 megs. negative, and 1—8 megs. positive side. With the time and trouble spent on this job we expected 5 megs. at least. The switch side being the lowest, we followed this out; if we switched off the lights a flat at a time, the test went up to 4 megs. gradually, not with a jump; we also picked out the worst switch, taking off same and ceiling rose, and got a test of infinity on the wire between the two fittings. After fixing on switch again, and testing between switch and earth, we got 20 megs.

If the inspector would give us the wrinkle how to capture a few of these megs. that seem to be flying about, and retain them till after the test, we would certainly be obliged to him.

I think, myself, that the inspectors should be asked to test jobs when piped and wired only, when they would have a better chance of seeing that all tubes were properly earthed, and then come a second time when the job was ready for lighting up; and if a contractor had several jobs, it could be arranged to test them all the same day, and compare the one with the other, according to the number of lights in each.

To bring in an outside inspector I don't think would work very well, and is not at all necessary, as a practical man with a good testing set would not go very far wrong. What I object to is the unsatisfactory way a job is left by the inspector when he refuses to pass the job; it would be a good thing if he could arrange to spend a little more time on the job and satisfy himself what really is the trouble. What I mean is, that he or his assistant should remain on the job till the fault is found, if there is any; and if the fault was a general thing all over, why not switch on the current for a few days before enforcing the fine of 10s. 6d., as a contractor is no more responsible for the fittings on a lighting job than he is for a motor (you can get both, cheap and nasty). But when a contractor gets his material from well-known makers, and does his level best to get his job up to Corporation test, or as near as possible without faking it up, as I have seen done many a time, he is entitled to some little encouragement. Even "Inspector" must admit that the small contractor is the means of getting a lot of consumers for the supply companies.

Foreman.

Station Notes.

In regard to your article on my "Station Notes," will you kindly allow me a few remarks by way of answer.

Firstly, with regard to the method of converting shillings and pence into the approximate decimal equivalent of a pound, no doubt this seems round-about to anyone who has to take pencil and paper to perform the calculations, but to anyone with ordinary proficiency in mental calculations, I can assure you the method is simple and suitable for ordinary work. It is also specially useful for turning the decimal results of slide-rule calculations back to shillings and pence.

With regard to the card systems, these are not yet in anything like universal use, and if no one were to write papers on subjects of this kind because the information could be obtained from catalogues, then surely papers on steam engines and switchboards and station plant in general would be prohibited. Indeed, if this idea were carried out to its logical conclusion, our electrical newspapers would have to cease using similar sources of information, and this would deprive them of much useful copy and their readers of a lot of good reading matter.

Owing to changes always taking place in our methods, one continually finds even successful stations which are deficient in some respect where one would not expect them to be lacking, and papers dealing with the practise in all departments will be a necessity for some time to come. Indeed, to such an extent is this true, that some even of our electrical newspapers—of which we are all proud—occasionally fall into gross errors, which require to be corrected by neighbouring journals.

With regard to the idea of running a dynamo from a locomotive, I am glad you pointed out the obscurity of the word "hitch" as used in my paper. I can quite understand how the writer of your article got misled as to its meaning, and hence drew the amusing sketch of a locomotive pulling a wagon loaded with a dynamo over a peak. I hope, however, some time to return to the subject, when I may make my meaning clearer.

With regard to the question of running turbines off the exhaust of steam and gas engines, I do not by any means claim this idea as original. I believe that the suggestion has really come from a very distinguished engineer, and has already been more or less discussed by people interested, although perhaps it has not yet become newspaper talk. This paper being given in the home of steam turbines, I did not consider it necessary to make any reference to previous writings, especially as I had not such references by me. But I think that the question may well be discussed, as it is quite likely that something may be done in this way.

C. Turnbull.

Tynemouth Electricity Works,
February 23rd, 1903.

Electrically Operated Printing Machinery.

As the engineer, then acting for Messrs. Geipel & Lange, who was responsible for the practical conversion of Mr. Ward-Leonard's ideas to actual working facts, for the first time in this country, at Messrs. Lloyd's, the description you gave of the plant has naturally been gratifying, and the criticism of "Electra" of great interest, as, having now no interest in the Ward-Leonard system, I may be considered as one of the few impartial persons who have actually made tests of the apparatus described.

These tests were carried out with considerable care on three occasions, and the instruments were within 1 per cent. of accuracy at any reading.

In fixing the size of the machines we were unable to obtain any accurate idea of the power required for the press, as it was the first of its large size erected in this country, and was still in the process of construction, while the maker's two factories put very different power values on it; the result is that at full speed with heavy impression and gummy ink the plant is overloaded, which takes off fully 1 per cent. of the through efficiencies under these circumstances, and this should be allowed for in the figures given below.

The system "Electra" describes has, undoubtedly, advantages in simplicity, but this seems from his figures to be bought, as it often is, at too high a price. His diagram shows the motors with maximum efficiency at about half speed, and this, as he admits, is not an important speed in real work.

The following table shows the relative efficiency of the three systems, rheostatic by resistance only, Ward-Leonard

as at Messrs. Lloyd's, and the "Electra," so-called, system, but in this case the figures must be discounted, as I give it credit for what is evidently impossible, *i.e.*, 100 per cent. efficiency at its most efficient speed.

Per cent. of maximum speed.	Per cent. through total efficiencies. Rheostatic.	Ward-Leonard.	"Electra."
3	1·8	27	8
10	6·7	48·5	18·8
25	21·5	71·2	57·5
50	43	86·2	100
75	65·5	77	72
90	81	78·4	68·5
100	88	79·7	66·6

The rheostatic control is calculated on the basis of the proved efficiency of the main motor now in use.

The 3 per cent. speed is about the lowest in "Electra's" diagram, and is also about the speed at which the press is run for a considerable proportion of its time, but what ratios of total energy are taken at the different speeds is not on record, so far as I know.

The 90 per cent. speed is the one at which Messrs. Lloyd's press was mostly run, when I had personal acquaintance with the work; the higher speed although gradually obtained was found trying to the paper and possibly also to the press, and was only used for emergency, when the capability of turning out an extra 6,000 copies per hour, of so big a paper as *Lloyd's Weekly*, has great value.

With high supply voltages, no difficulty arises, as they are also easily dealt with under another application of Ward-Leonard's patents, which are comprehensive in their nature, but being drawn up originally by a U.S. Patent Attorney are almost too long and intricate to get a grasp of, unless one is compelled to for definite reasons.

"Electra's" diagram shows, as he states, 4·6 KW. suddenly thrown on the mains for a 30-H.P. motor, whereas at Lloyd's only about 1 KW. is required for a 60-H.P. set. The main motor, being switched on when the motor-generated voltage equals the line voltage, makes no demand for energy at that moment.

To my mind, the great advantage of the Ward-Leonard system is its great speed regularity with varying torque, and the almost constant armature current, making it possible to secure, if desired, the extra efficiency of metal in place of carbon brushes (in the present instance this was not done, owing to the necessity of using a standard make of machine).

In spite of the above, I, like "Electra," believe there are now better systems available, but the plant in question was put on order over two years ago, and has, I know, more than justified its selection.

I hope some of your readers will be able to give you some results with the Holmes-Clatworthy, Bullock, and other systems in practice.

Justus Eck.

London, *February* 21*st*, 1903.

Our attention has been called to a letter appearing in your issue of the 20th inst., regarding the application of the "Ward-Leonard" system to the driving of a printing press at Messrs. Lloyd's. Your correspondent, "Electra," in his desire to advance the claims of some system in which he appears to be interested, commences with the premise that in the case under discussion "the units consumed in the making-ready process are infinitesimal, and that all the energy is used at full load." For such conditions, no doubt his system would be excellent; in fact, it would appear to us that an ordinary motor controller, such as is made by the Ward-Leonard Co. and other manufacturers, would suffice for that. But the conditions at Messrs. Lloyd's are totally different, as was pointed out in the article which appeared in a previous issue of yours; it is hardly necessary, therefore, for us to discuss the calculations which he has based upon the power required on the "Ward-Leonard" system for driving a 60-H.P. motor, assuming, as he has done, that it always runs at full speed, as compared with a motor on his system having a maximum of 30 H.P., which we observe takes no less than 20 amperes at full voltage for the mere inching round of the press. We repeat, the conditions at Messrs. Lloyd's and, in our experience, also with other large printing presses, are quite different; a considerable time is occupied in inching round, and the press is rarely run above three-quarters of its maximum speed, for it is customary to have some margin as an emergency speed, for obvious reasons. Further, it is a desideratum to have a system which provides constant speed, no matter what the load may be at any point between inching round and full speed.

The claims he makes for his system are somewhat droll. He says: "It is, in fact, more remarkable for what it is not than for what it is; the speed curve is almost a straight line, so also is the current." Certainly the curve he gives is remarkable in that respect, for it is as far from a straight line as it well could be; it is, indeed, a very different curve from what would have been obtained with the "Ward-Leonard" system.

Geipel & Lange.

Westminster, *February* 23*rd*, 1903.

Electrolytic Meters.

I am glad my letter has attracted Mr. Bastian's attention, and am pleased to take this opportunity of replying to his courteous letter of the 20th inst.

With regard to the question of identity, I think it fairer that readers of this correspondence should know me as "Electron," as the publication of my name, and consequently the undertaking I am connected with, could not but be prejudicial to the sale of the meters in question.

I can assure Mr. Bastian that the curve I published in my previous letter is in no way *abnormal*. The meter I tested was *not* an "old" one, being supplied to us within the last few months. I have since corroborated the test in the following way:—24 exactly similar meters were only half filled with water (they had, of course, their full 6 drams of acid), so as to be under average conditions. I never said that the volt drop was materially decreased by the addition of acid—*it is not*. These 24 were then connected in series by stout copper connections, and switched straight on to a 130-volt battery with nothing but a low resistance ammeter in circuit. The result completely substantiated my former test. After a few minutes, when the current became steady, the mean current taken for two hours' run was 10 amperes exactly, and the voltage across the meter terminals 127·2, which is in perfect agreement with my previous statement—5·3 volts per meter on full load. All the instruments employed have been carefully checked before accepting these figures.

If these results are still considered "abnormal," the company can only blame themselves for sending us so many of what your correspondent calls "niggers." I am sorry Mr. Bastian perverts my remarks about 2½-ampere meters, when he must know perfectly well what the drop in these instruments really is. Speaking of 10-ampere meters, I said, "The voltage curve for a 2½-ampere meter is almost identical." I am sure that would be generally understood to mean size for size—the 2½ meter at 2½ amperes has the same drop as the 10-ampere meter at 10 amperes. Anyhow, that is how I meant it, and it is perfectly correct. I am not in such a hurry to rush into print that I should make statements I could not prove.

Your correspondent's suggestion that my tests should have been on small size meters is irrelevant; all sizes I have tested have the same voltage drop on their rated full load. The function of a meter is to record energy—(*a*) with accuracy; and (*b*) with efficiency—*i.e.*, absorbing only a very small fraction of the energy recorded; when (*a*) and (*b*) are high, the meter is a good one. On the score of efficiency, therefore, I say that the Bastian meter (200 volts) with its 97·4 per cent. at full load is not so good as many other *ampere-hour* meters showing well over 99 per cent.; and I fail to see any inconsistency in this statement. I must apologise for the terrible length of this letter, and, in conclusion, assure Mr. Bastian that I have not the slightest quarrel with him, and that my letters are entirely the outcome of his somewhat rash "test on a disinterested individual," being written to try and put the matter on a satisfactory basis.

Electron.

February 23*rd*, 1903.

Your correspondent of last week, who calls himself "Glimmer," may be congratulated on having chosen a very appropriate *nom de plume*, for he evidently has only a glimmer of an idea what the correspondence is about, or how to calculate the loss due to drop in volts on a meter.

I shall be pleased if you will allow me this opportunity of reminding him that the discussion refers to the use of electrolytic meters for measuring energy taken by *small* consumers when supplied at a pressure of 200 volts or more.

Thus, if we take as an example a consumer wired for 30 or 40 8-c.p. 200-volt lamps, a 5-ampere meter would be installed; then, granting for the sake of argument that "Glimmer's" curve of drop in volts is correct, the following facts are obvious:—

1. That the maximum loss, if the consumer were using full load all the year round, would be 2 per cent., and not 5 per cent., as "Glimmer" states.

2. That with an ordinary consumer using, on the average, one-fifth of his full load, the loss would be less than 1 per cent.

I should also like to remind your readers who are interested in the discussion, that the load factor of a generating station can be considerably improved by encouraging consumers with a small number of lights; for instance, a house or shop wired for five lamps, will probably burn two or three lamps for several hours a day, thus the maximum demand will approximate to the average demand; but the encouragement of this class of consumers would be useless if a cheap meter, accurate at all loads, were not available; the Bastian meter fulfils these requirements, with the result that it has been, and is being, installed in large numbers by borough and other electrical engineers.

Haydn T. Harrison.

February 23rd, 1903.

[To "R." and all correspondents.—We have been compelled to leave out a letter from "R." on this subject, as it teems with personalities. If our correspondents will confine themselves to matters of real technical and commercial interest, and refrain from personal references to individuals, our editorial duties will be considerably lightened, and their own chances of obtaining publicity will be greater. We are always ready to welcome letters on any matter of interest to the electrical profession and trades, but we appeal to writers to keep within the bounds of prudence as to both the length and the strength of their remarks.—Eds. Elec. Rev.]

Patents for Sale.

All associated with a quickly developing industry, like the electrical one, are constantly working with new apparatus. That is, apparatus which may be extensively used, but is far from being perfect, or at least being constantly in contact with it cannot fail to reveal its deficiencies. When the latter are properly understood, it is frequently an easy matter to devise improvements; but how to take advantage of such improvements is a difficult matter. This is a subject which may be safely said to interest a large number of your readers. By allowing those who have had experience with such matters to avail themselves of the hospitality of your columns to state their views, you would bestow a great favour on

Omnes.

Intermittent Currents for Electric Lighting.

I am sorry that pressure of other work has prevented my replying earlier to Mr. Rankin Kennedy's letter in your issue of January 30th. It is hardly surprising that some of my ideas should have suggested themselves to so prolific an inventor as Mr. Kennedy, and it is a pity that he should have allowed himself to be discouraged by adverse criticism from going on with a good invention. If I remember rightly, the three-wire system of distribution was condemned by certain experts in similar terms at about the same date. Since seeing Mr. Kennedy's letter I have re-examined his patents, but find nothing in them to interfere with the validity of mine.

S. H. Holden.

Erdington, *February 24th*, 1903.

[See also our "Notes" columns.—Eds. Elec. Rev.]

LEGAL.

Gilchrist v. Hereford-Lavey & Chapman.

In the King's Bench of the High Court of Justice last week, Mr. Justice Ridley, sitting with a common jury, disposed of an action brought by Gavin Gilchrist, an electrical engineer, at Manchester and St. Annes, Lancashire, against Hereford-Lavey & Chapman, agents for electrical fittings, and carrying on business at Grosvenor Mansions, Westminster. Plaintiff claimed damages for alleged false and fraudulent misrepresentations, which induced him to enter into a contract with the defendants for loss of profits under that contract; and for the sum of £212 5s. 2d., which he alleged was overpaid by him to the defendants. Defendants denied that they made these representations, or that if made they were false and fraudulent. They denied that they received the money claimed, and they put in a counterclaim against plaintiff for the sum of £267 8s. 6d., as balance of price of goods sold and delivered.

When the case was called a gentleman in Court intimated that he was the junior member of the defendant firm, and having regard to certain facts which had come to his knowledge, he did not propose to defend the action. He had served notice on the senior member of the firm that he was acting personally in this matter.

The other defendant in the case was called in Court, but he did not appear, and there was no counsel present representing him.

Mr. Lush, K.C., for the plaintiff, said he would shortly prove his case. Towards the end of 1901, Mr. Hereford-Lavey was in Manchester, and saw Mr. Gilchrist whose acquaintance he had formerly made. He was very anxious that Mr. Gilchrist should apply for the post of agent to sell some electric plant and goods which were being sold by a company of considerable importance called the Electric Lighting Boards Co. That company had some new arrangement for electric lighting, and Mr. Hereford-Lavey interested Mr. Gilchrist in it, and asked him to accept an agency for this company. He also said he would make it worth Mr. Gilchrist's while to make a contract under which he should act as agent for Messrs. Lavey & Chapman to sell other electrical goods. By means of his statements, every one of which was false, Mr. Gilchrist was induced to enter into a contract in 1901, under which Mr. Lavey got from Mr. Gilchrist £750 down in the from of a cheque; an agreement to order £1,500 worth of goods from him; an agreement to order no less than £6,000 worth of goods from Lavey and Chapman during his first year; and one in which he bound Mr. Gilchrist not to sell electrical fittings to clash with these goods. Mr. Lavey also bound him to rent premises in Manchester to carry on the pretended business. Mr. Lavey told Gilchrist that he was the managing director of the Electric Lighting Boards Co.; that he and his partner were the sole agents for the company's goods; and that they were, therefore, in a position to transfer the agency to the plaintiff. It was on the faith of these statements that Mr. Gilchrist entered into the contract. A few weeks afterwards he found that Hereford-Lavey had no right to give him the agency. Plaintiff had been put to great expense in connection with premises at Manchester, and every sixpence of the money he had spent on them had been lost.

Mr. Gilchrist was called and gave evidence. He stated that he carried on business at Manchester and St. Anne's. In December, 1901, he saw samples of the electric lighting boards, and had an interview with Mr. Lavey at the Queen's Hotel, Manchester. Mr. Lavey told him that the turnover of the agency was £6,000 per annum. The agency was to be for one year with the option of a further continuance for two years. Mr. Lavey stated that he had a contract for the New Brighton Tower Co, for £3,750, the Blackpool Winter Gardens for £2,500; the Shakespeare Theatre, Liverpool, £700; the Empire Theatre, Liverpool, between £700 and £1,000, and the Grand Theatre, Blackpool, £1,500. If he (plaintiff) took over the agency, Mr. Lavey said that these contracts would be put to his credit. Mr. Lavey, in further conversation, remarked that he had an offer from Veritys to take over the agency, but that he wanted to have a firm to devote the whole of their time to it. Mr. Lavey approved of plaintiff taking premises in Manchester which, with rent, alterations, &c, involved an expenditure of £1,500. In the course of further evidence plaintiff said that Mr. Lavey sent £300 worth of goods on approval. None of them were ordered, whilst £122 worth of goods invoiced as new were damaged goods. He had paid £1,500 in respect of premises and alterations, and besides £200 odd which he had paid over to defendants, he had a loss of profits which he estimated at £4,000 for the period covered by the contract.

Mr. Alex. Cooper, a Manchester buyer, said he had been assisting Mr. Gilchrist, who would have made a profit of about £1,000 a year. The sale of such things was very extensive.

Mr. Ernest Brownstone, electrical engineer, Picadilly, Manchester, said he had been manager and also traveller for Mr. Gilchrist. For a turnover of £6,000 a year under the guarantee, a fair profit to expect would be about £1,000 per annum.

Mr. William Wilson, electrical engineer at the Winter Gardens, Blackpool, denied that any goods had been ordered. There was no contract.

Mr. John Gatney, manager of the Shakspeare Theatre, Liverpool, Mr. William Cole, electrician at the Grand Theatre, Blackpool, Mr. Harold Davey, secretary of the New Brighton Tower Co., Liverpool, and Mr. Thos. Ainslie Cook, manager of the Empire, all gave evidence to the effect that their respective companies had not done any business whatever with Hereford-Lavey & Chapman. The last-named witness said he had never heard of Hereford-Lavey and Chapman.

Mr. Lush, in summing up the case, said Mr. Hereford-Lavey had

deliberately made wicked and false statements to induce Mr. Gilchrist to spend a large sum of money.

His LORDSHIP, in addressing the jury, said Mr. Lavey appeared to have made fraudulent representations which were absolutely without foundation. He had represented that there were contracts to the value of over £9,000. The question was simply one as to what damages plaintiff ought to recover. The money plaintiff expended on the premises came in round figures to £1,500. There was no one to dispute that item. Then, as to the purchase of goods, plaintiff had paid for more than he had received. The difference of £213 was a sum he was also entitled to receive. In addition to that, there was the loss which plaintiff had suffered owing to the contracts not being in existence. It was for the jury to say what should be given plaintiff in respect of loss of profits for the three years.

The jury returned a verdict for plaintiff, and put the sum to which he was entitled at £4,500.

His LORDSHIP gave judgment for that sum, made a rescession of the agreement which formed the subject of the action, and gave judgment for the plaintiff on the counterclaim.

THE BLACKPOOL ELECTRIC TRAMS.

IN the King's Bench Division of the High Court of Justice on Saturday, before Mr. Justice Darling, sitting without a jury, the case of Gates *v.* The Electric Trams Construction, &c., Co., Ltd., was heard.

Mr. BOYDELL HOUGHTON, who appeared for the plaintiff, said the latter brought the action to recover £51 11s. 4d., the amount of two dividends payable upon 100 shares of £10 each in the Blackpool Electric Tramways (South) Co. It appeared that the defendant company entered into a contract to convert the Blackpool, St. Ann's and Lytham Tramway, which was a horse tramway, into an electric tramway. In order to do so they took over the shares and debentures of the old company and formed a new company, called the Blackpool Electric Tramways Co. They issued a prospectus for a company with a capital of £100,000, with 5½ per cent. preference shares, and they sent out the prospectuses, amongst others, to Mr. Gates, the plaintiff, he having some knowledge of the neighbourhood. He, in response, subscribed for 100 shares. The prospectus and circular that were sent to him stated that interest would be paid during construction by the defendant company, who were the contractors. It could not, it appeared, be paid by the company itself as it was not earning anything during construction. The first payment of interest was duly made by the defendant company. The second payment became due in July last, and the third in December, but these had not been made—hence the present action. He understood that defendants said that the construction of the tramway had not commenced and that that was the reason why they had refused to pay.

There was no appearance for the defendant company, and his Lordship gave judgment for plaintiff for the amount claimed, £51 11s. 4d. and costs.

THE TELESCRIPTOR SYNDICATE, LTD.

ON Saturday in the Chancery Division, Mr. Justice Buckley gave judgment on an application made under Sec. 89 of the Companies Act of 1862 for staying all proceeding under the winding-up of the Telescriptor Syndicate, Ltd. The application was made by Mr. Claude Scott, secretary of the company.

His LORDSHIP said he was empowered to make an order staying proceedings, when it proved to the satisfaction of the Court that all proceedings ought to be stayed. The Telescriptor Syndicate was incorporated on April 22nd, 1896, with a capital of £40,000 in £1 shares, with the object of entering into an agreement for the purchase from Bernard Hoffman, of certain patents for the sum of £35,000 in fully-paid shares. The memorandum of association was subscribed by seven persons, and on the next day the majority of the subscribers signed a document appointing as first directors, Mr. Roger Wallace, K.C, a well-known member of the Bar, Mr. Paul Hoffman and Mr. Bernard Hoffman. At a board meeting of the same day, when Mr. Wallace and Mr. Paul Hoffman were present, a letter was read from Bernard Hoffman, the vendor, by which he directed that out of his 35,000 shares, Mr. Wallace, or his nominees, was to receive 14,250 shares; to certain others smaller numbers, and 17,000 shares to the vendor himself. On April 29th orders to seal the whole of these shares, except Mr. Wallace's 14,250 were given. Of the 4,993 shares which remained after the allotment of the shares to the signatories, applications were received from the late Dr. Hopkinson, Mr. Hayes Fisher, Sir Joseph Lawrence, M.P., and Mr. Wallace for 1,000 shares each, Mr. Hayes Fisher and Sir J. Lawrence having on July 30th, 1896, been appointed directors. On August 5th, 1897, applications were received from Mr. Wallace and Sir J. Lawrence for 250 shares each, and on February 4th, 1898, Mr. Wallace was allotted 124 shares, and Sir J. Lawrence, Mr. Hayes Fisher and Dr. Hopkinson 123 shares each. It was stated, and he had no reason to doubt the statement, that the 4,993 shares were paid for in cash. On November 18th, 1898, Dr. Hopkinson was appointed a director, and at the time of the winding-up, Mr. Wallace, Sir J. Lawrence, Mr. Hayes Fisher, Dr. Hopkinson and Mr. Paul Hoffman were directors, Mr. Bernard Hoffman having ceased to be a director. Of the 14,250 shares, 2,000 were each transferred to Sir J. Lawrence, Mr. Hayes Fisher and Dr. Hopkinson, and 8,250 to Mr. Roger Wallace. It appeared to him that the fact that the four directors received from the vendor a block of 14,250 shares was one that excited attention—he purposely used a neutral word—and it ought to be looked into. From the minute-book he learned that the financial position of the company grew worse and worse. The company never traded, in the sense that it worked the patents or sold goods, and he was not clear exactly what it did. On December 2nd, 1901, the bank balance, which had been shrinking persistently for a long while, came down to £7, and the petty cash had been over-drawn. The Westminster Trust, Ltd., were the lessors of the offices occupied by the company, and on February 20th, 1900, the secretary of the syndicate reported having received an application from the Trust for rent, and it was resolved that the secretary should endeavour to arrange for the Trust to accept debentures as collateral security. The claim of the Trust was not met, and on August 1st, 1902, the secretary reported that a writ had been served for £318, and it was resolved by the directors present, Mr. Roger Wallace and Mr. Paul Hoffman, to let matters take their course. The Westminster Trust therefore recovered judgment, and on November 7th a petition was presented for the winding-up of the company, and on November 25th a winding-up order was made. On November 27th the Official Receiver sent to all the directors and to Mr. Claud Scott the usual notice calling upon them to arrange to attend before him on December 3rd to give him information as to matters which he detailed, but none of the directors attended, or by writing or otherwise made any response to the request. Mr. Scott did attend and stated that it was the intention of the directors to apply for a stay of proceedings in relation to the winding up. The Official Receiver on December 9th wrote that failing a stay of the order being made, he had no option but to proceed. On December 17th the Official Receiver made a second appointment for December 19th, but neither Mr. Wallace, nor Mr. Hayes Fisher sent any reply, but Sir J. Lawrence on December 23rd wrote that he did not know that any rent was due to the Westminster Trust. That gentleman, under the circumstances, took up a position which was justified, and it could not be said there was no intention on his part to go to the Official Receiver. Again, no director put in an appearance, and on January 13th a third notice was sent to all the gentlemen to attend on January 16th. In that state of things a notice of motion for a stay of proceedings was served on January 15th. Mr. Scott filed an affidavit, in which he stated that the claims of all the creditors had been settled, but the Official Receiver said he had no information upon that point. It appeared from an entry in the company's minute-book that some of the directors received large blocks of fully-paid shares as nominees of the vendors of the company, and he was informed that some of the shares were transferred by way of bonus. Mr. Scott could not give any further information because he was not appointed secretary until some months after the formation of the company. The company never issued a prospectus. As far as he could see, the persons who became interested in the shares were those he had mentioned, with the exception that he found in the minute-book on July 28th, 1897, that a large number of transfers were passed to people whose name did not convey any information at all. As regard the principle of law where an application was made in bankruptcy to rescind a receiving order, or to annul an adjudication, the Court refused to act on the assent of the creditors, and considered not only whether what was proposed was for the benefit of the creditors, but whether it was conducive to commercial morality and to the interests of the public at large. He was asked to exercise an analogous jurisdiction, and it was desirable that so far as possible the Court should not assume a different duty or act on a different principle in the winding up of a company, or in the bankruptcy of an individual. He was asked to say that it had been proved to his satisfaction that all proceedings in this winding up should be stayed, and he declined to say that, because of the mere fact that since the winding-up order was made the assent of the creditors and of a large majority of the shareholders had been obtained. How that assent had been obtained he did not know. He knew that when the secretary reported that service of the writ to recover the debt in respect to which judgment was obtained, the directors resolved to let matters take their course. After the matter had taken its course, the petitioners and other creditors had in some way been induced to assent to a stay of proceedings. He was entitled, and he desired, to know why. The facts which he had stated as to the appointments which the Official Receiver had made for the attendance of the directors and the bringing in of a proper statement of affairs might all be capable of explanation. He did not wish to prejudge the case in any way. It was possible—he would not think it was probable—that a member of the Bar and two members of the Legislature were absent from the country, and did not receive the notices calling upon them to do that, the omission of which was a misdemeanour punishable by a penalty. Again, as to the affairs of the company while in operation, they might be altogether right; he did not for a moment say it was not so, but it was possible that there might be an ugly side to that picture, and he was entitled to know whether there was that ugly side. It was also possible that these gentlemen would not come in and submit a statement of affairs because there was something to conceal, but this, in their own interests, ought to be cleared up. They, as good citizens, ought to have come in and stated that everything was fair and above-board. They must explain why they stayed away and did not perform the duty imposed on them. He did not for a moment say how the facts might work out, but the case would not be proved to his satisfaction until it was shown—as he hoped it would be shown—that all the affairs connected with the company had been fair and above-board. He directed the motion to stand over until next Tuesday four weeks, and it would be the duty of the Official Receiver, after considering the statement the directors would furnish, to state whether, in his opinion, further inquiry was desirable.

His LORDSHIP concluded his judgment by expressing a hope that the directors would discharge the duty which gentlemen in their

position ought to have known they owed to the public, and he trusted that when he had all the facts before him, he could make the order asked for. If, however, he was not satisfied, he would not do so.

BUSINESS NOTES.

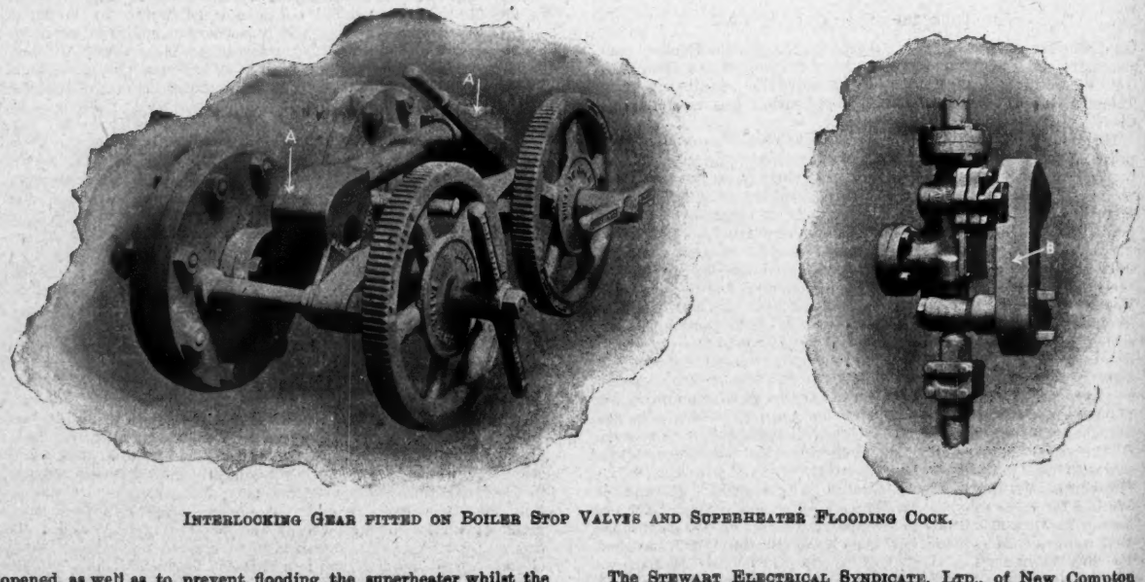
Electrical Wares Exported.

Week ending Feb. 25th, 1902		Week ending Feb. 24th, 1903.	
Adelaide	Value £180	Adelaide	Value £35
Alexandria	42	Alexandria	85
Bangkok	30	Amsterdam	60
Brisbane. Teleph. cable ..	528	Auckland	92
Calcutta	1,679	Bangkok	59
Canada (*via* the States). Teleg. mat.	16	Bombay	150
Cape Town	477	Boulogne	54
Colombo	268	Buenos Ayres	81
Constantinople. Teleg. mat..	35	,, Teleg. mat. ..	209
Copenhagen. Teleg. wire ..	153	Calcutta ..	1,386
Durban	296	Canada, *vid* United States ..	65
East London	424	Cape Town	693
Greymouth	178	Colombo	225
Hong Kong	265	Durban	1,817
Lyttleton	550	East London	573
Malta. Teleg. cable	12,960	Fremantle	384
Melbourne	150	,, Teleg. wire ..	454
New York	60	Gibraltar	28
Perth	150	,, Teleg. mat.	11
Shanghai	81	Gisborne	70
Stockholm. Teleg. cable ..	65	Hamburg. Teleg. cable ..	1,030
Sydney	57	Hong Kong	16
Wellington. Teleg. wire ..	884	Madras	308
,, Telephones ..	925	Melbourne	598
		Messina	10
		Perth	132
		Port Elizabeth	243
		,, Teleph. mat. ..	159
		Rio de Janeiro	29
		Rotterdam	150
		Shanghai	540
		Singapore	111
		Sydney	745
		Tientsin	242
		Wellington	122
		,, Telephones ..	925
Total ..	£20,153	Total ..	£11,891

Foreign Goods Transhipped.

Barbadoes. Teleg. mat.	Value £65	Paris. Elec. mat. ..	Value £26
Calcutta. Elec. light fittings ..	81		
New York. Elec. mat.	80		
Trinidad. Teleph mat.	44		
Total	£270		

Interlocking Gear for Superheaters.—One of our correspondents recently referred to the apparatus devised by Messrs. Babcock & Wilcox, Ltd., to avoid omission to drain the superheater, and thus prevent water being passed through the steam pipes into the engine cylinders when the boiler stop valve is opened, as well as to prevent flooding the superheater whilst the boiler stop valve is open. One locking key for the stop valve, flooding valve and drain valve is provided separately for each boiler for this purpose. The apparatus consists, as will be seen from the illustrations, of two cast-metal boxes, A and B, which are fixed under the bridge of the stop valve and on the flooding cock respectively. At the bottom of the box A there is a stud, having a catch which is kept in position by a steel spring. This catch rests on a cast-metal cup fixed on the stop-valve spindle, and thus locks the valve. When this is the case the key *can be removed* and the flooding cock opened. By turning the key to "Open," the catch goes through a movement of a quarter turn, thus disengaging the stop-valve spindle. In this position the key *cannot be removed*, and the stop valve can be opened. The box B over the flooding cock covers an arrangement of levers connected by a link, and fixed on the plugs of the flood and drain cocks. The movement of these levers is confined to 90°. The locking handle consists of a box key fitted with two wards on the bottom of the key, which engage two corresponding recesses on the lever of the drain cock, and one at the side, which fits into suitable openings in the boxes on the stop valve and the flooding cock. The number of the keys and the position of the wards may, of course, be varied and combined in a number of ways to render the device suitable for a large battery of boilers. In cases where the boiler stop valves are operated from the stokehold floor, the lock is fitted to the hand-wheel and modified accordingly. Each boiler has a locking key fitted with different wards, thus preventing the key from one boiler being used on another. This arrangement can, with slight modification, be applied to any make of valve and adapted to existing plants, as was done in the case referred to by our correspondent, with entirely satisfactory results.



Interlocking Gear fitted on Boiler Stop Valves and Superheater Flooding Cock.

Electrical Launches for Venice.—Although a project for the adoption of electric launches for the public service, which was laid before the Municipality of Venice by some Venetian gentlemen a couple of years ago, has for various reasons fallen through, Consul de Zuccato is of opinion that there would be a good opportunity for a sound British company to lay a serious proposal before the municipality. Such a proposal, he thinks, would not be viewed with disfavour by the Town Council, inasmuch as the steamers running on the Grand Canal are alleged to damage, by a gradual process of erosion, the foundations of the historical palaces on the canal. Moreover, the continuous smoke of their engines is stated to injure the picture galleries. When the Cellina Electrical Works are in operation the motive power will be easily obtained and stored for distribution to the launches. These should be of various dimensions, of a narrow type for passing through the small canals intersecting the town, and of a larger type for running on the Grand Canal and the Venetian lagoon. The launches would in this way be able to perform an omnibus service to all parts of the town, some of which are now entirely cut off. An extraordinary development might also be given to the conveyance of passengers to the mainland and the neighbouring islands in a quick, comfortable, and cheap way. The speed of the small steamers has been greatly reduced since the fall of the Campanile, by order of the authorities, much to the disadvantage of the public service. No time should be lost in submitting the project to the municipality, and the Consulate would at any time be happy to render every possible assistance.

Catalogues and Lists.—Leaflets relating to the "Geeko" battery buttons (sal-ammoniac pellets), and the "Bellophone" for connecting to existing electric bell systems, have come to hand from the General Electric Co., Ltd.

A catalogue of accumulators and sundry accessories for electric ignition purposes has been published by Messrs Peto & Radford, Ltd.

The Stewart Electrical Syndicate, Ltd., of New Compton Street, W.C., have sent us a couple of catalogues of the manufactures of the Sterling-Meaker Co., of Newark, N.J., U.S.A., for which they have been appointed sole agents for the British Isles. One of the lists gives a well illustrated description of the Sterling fare registers; the other fully particularises the Sterling safety brake for electric tramcars.

Messrs. Johnson & Phillips, of Old Charlton, have prepared an excellent catalogue devoted to their well-known "Ark" lamps and arc lighting accessories. The illustrations, some of which are capital specimens of art colour printing, include photographic views of street lighting work done by the firm at East Ham, Mexborough,

Blackheath, &c., also some elaborate designs of lamps for hotel service, coloured globes, various designs of lamp pillars, and special swinging wall brackets. The patent photographic "Ark" lamp, mounted on portable tripod stand, with sliding bracket frame, enabling the lamp to be raised or lowered to suit printing frame, is also shown. A good deal of descriptive matter is given, as well as a list of users, and some good testimonials. Messrs. J. & P. will send a copy of this catalogue to any member of the trade on application.

A circular has been sent to us by MESSRS. RICHARD KLINGER AND Co., of 66, Fenchurch Street, E.C., giving some details of their Reflex water gauge. It is claimed to obviate all the risks attendant on the use of ordinary glass tubes; it is entirely made of metal with the exception of the thick corrugated observation glass. This glass is said to resist the highest pressure, and to indicate plainly to observers whether a boiler is working safely or otherwise.

A list showing their high voltage quick-break socket and plug has come to hand from MESSRS. HEATON & SMITH, LTD, of Pendleton.

MESSRS. JOHN DAVIS & SON, of Derby, have just brought out a new section A of their catalogue containing many photographic reproductions showing their mining, surveying, engineering, mathematical and meteorological instruments, also miners' safety lamps. Details and prices are given, and we believe that many of our readers will find the list to be a useful one.

The BRITISH PROMETHEUS CO., LTD, have placed before us a copy of their current "B" catalogue in which the "Prometheus" system of electric heating and cooking is very fully described. The trade will be able to obtain a copy of the list on application to the company at 18, London Road, Kingston-on-Thames.

A new price list (No. 2) of small motors, polishing and fan motors, for continuous, alternating and three-phase current, has been issued by the ELECTRICAL CO., LTD. It is got up in the company's usual style, with handy finger index to sections. There are many diagrams and other illustrations, and much necessary data is arranged in tabulated form for ready reference.

Works Extensions.—The works of the English Electric Manufacturing Co., at Preston, are being extended: the new departments to be added are for insulating and winding, and brass work.

Cricket Club Notice.—A cricket club has been formed in connection with the works of the Anti-Vibrator, Ltd., of Limes Road, Croydon. All dates are open, and Mr. W. H. Smith, the club secretary, would be glad to hear from other club secretaries re fixtures.

Dissolutions and Liquidations.—Mr. Justice Buckley on Wednesday last week had before him a petition by Disconto Maatschappij for the compulsory winding up of the New Imperial Electric Lamp Co., Ltd. Counsel for the petitioner said he was a judgment creditor for £163. The company opposed the application. It was stated on behalf of the company that they had made heavy losses, but that they were entering on a busy season, and if a little time were given them they would be able to meet the claims. His Lordship said an Official Receiver had been appointed by Mr. Justice Byrne, and the question was what should be done having regard to the special report of the Official Receiver. The object of the company was to carry on the business of importers and dealers in electric lamps. The Official Receiver reported that the assets were very small, and they certainly did not amount to such a figure that his Lordship should be disposed to make a winding-up order except in particular circumstances. Gustav Doring and Paul Doring had been requested to produce accounts and books showing the position of the company, but that had not been done. In the absence of these books and accounts the Official Receiver was unable to express an opinion as to the matters arising out of the company's trading. So far as the company's affairs had been disclosed to him, the Official Receiver was of opinion that there were not any matters connected with the company or the management thereof that would make a winding-up order desirable for the purpose of such matters being investigated. The Official Receiver added that his information was, however, limited at the present time by the absence of the accounts and books. Proceeding, his Lordship said he would have hesitated to make a winding-up order, unless the petitioners were prepared to become responsible for costs in the event of the company's assets becoming exhausted. He would make a compulsory winding-up order with the usual order as to costs, and he would limit the Official Receiver's powers in the first instance to enforcing a statement under Sec. 7 of the Companies Winding-up Act, 1890, the petitioners undertaking that they would personally be responsible for the costs of the winding up thus limited should these not be covered by the company's assets. When the statement had been enforced, application could be made to the Judge for further directions.

The first meetings of creditors and contributories of the British Power, Traction and Lighting Co., Ltd., of York, will be held at Carey Street, W.C., on March 4th.

A meeting of the New Electric Light Syndicate will be held on March 26th at the Clock House, Arundel Street, Strand, to hear an account of the winding-up from Mr. J. G. Dalzell, the liquidator.

A petition for winding up Desrumaux's Automatic Water Softener and Purifier is to be heard on February 19th.

The Electric Royalties Syndicate is winding-up voluntarily, with Mr. W. H. Darvell, of Grosvenor Mansions, Victoria Street, as liquidator.

Notice is given of a first dividend of 13s. 4d. in the £ in the case of Harry South & Co., Ltd., of Garrick Street.

Messrs. W. Blenkarn & G. E. Wright (Blenkarn & Wright, electrical engineers, 11, Queen Victoria Street, E.C.), have dissolved partnership. Debts will be attended to by W. Blenkarn.

Messrs. T. Rigbye & W. Smith (Rigbye & Smith, electrical engineers and contractors, Southport and Birkdale) have dissolved partnership. Mr. Rigbye attends to debts.

Parliamentary.—The Deputy Chairman of the House of Commons has reported that, in accordance with Standing Order 79, he had conferred with the Chairman of Committees of the House of Lords for the purpose of determining in which House of Parliament the respective private Bills should be first considered, and they had determined that the following Bills, containing clauses of an electrical character, shall originate in the House of Lords:—Antrim, Down, Armagh and Belfast Electric Power; Aston Manor Improvement; Birmingham Corporation; Birmingham District Tramways; Bournemouth Corporation Tramways; Bradford Corporation; Brighton Corporation; Carmarthenshire Electric Power; Chard Corporation Gas and Electricity; Chatham and District Light Railways; Cleveland and Durham County Electric Power; Dewsbury, Batley and Birstal Tramways; Dudley, Stourbridge and District Tramways; Exeter Corporation; Gosport, Fareham and Cosham Tramways; Hastings Tramways (extensions); Hove, Worthing and District Tramways; India-Rubber, Gutta-Percha, and Telegraph Works Co.; London, Brighton and South Coast Railway; Macclesfield and District Electric Tramways; Manchester Corporation; Manchester Southern Tramways (Cheshire); Manchester Southern Tramways (Lancashire); Mid-Yorkshire Tramways; North Cheshire Tramways; Nottinghamshire and Derbyshire Tramways; Pontypridd Urban District Council; Poole and District Electric Traction; Preston and Horwich Tramways; Rochester Corporation Tramways; Salford Corporation; Shropshire, Worcestershire and East Derbyshire Electric Power; Somerset and District Electric Power; South-Eastern and London, Chatham and Dover Railways; South Lancashire Tramways; South Staffordshire Tramways; Sutton Coldfield Corporation; Tynemouth and District Tramways; Wakefield and District Tramways; West Bromwich Corporation; Willesden Urban District Council; and Worthing Corparation (Tramways).

Scotch Bills.—The Chairman of Committees of the House of Lords, and the Chairman of Ways and Means in the House of Commons, have reported that the provisions of the following Scotch orders are of such a character that they ought to be dealt with by private Bills, and not by provisional orders:—Fife Electric Power, and Part III. of the Hamilton, Motherwell and Wishaw Tramways Order. The inquiry, will, therefore, be before a Select Committee, the same as with English Bills.

Chatham and District Light Railways (Tramways, Tramroads and Electrical Power).—This Bill came before Mr. Campion on Monday for proof of compliance with Standing Orders, when it was found that Standing Orders had been complied with in the case of the House of Commons, but not in the House of Lords, owing to the operation of the Standing Order which provides that all consents of local authorities must be obtained before January 18th. Although all the consents have been obtained, it was not accomplished by this date, and accordingly the Bill will have to go before the Standing Orders Committee, who will decide whether it shall be allowed to proceed. The Standing Order referred to is a new one, and applies only to the House of Lords; it has resulted in several Bills this session being reported as "non-compliant."

Trade Announcements.—The Electrical Transmission Co., of Hammersmith, have appointed sole agents as follows:—Manchester and district, Mr. S. Burton Edwards, 5, Cromford Court, Market Street, Manchester; Newcastle-on-Tyne and district, Mr. W. A. Chandler, Station Chambers, 10, Neville Street, Newcastle-on-Tyne; Scotland, Messrs. Davidson & Steel, 74, York Street, Glasgow.

Messrs. H. H. Vivian & Co., Ltd., of 132, Upper Thames Street, E.C., are now making special hard-drawn brass rods, which will stand a breaking strain of 37 tons per square inch, with an elongation of 5·25 per cent.

The "Emitevas" Electrical Fittings Co. have removed from 31 to 37, Brooke Street, Holborn, E.C.

Embezzlement.—At Maidstone Assizes on Monday, Frank Edward Beeton, late secretary to the Dover Electricity Co., Ltd., was sentenced to three years' penal servitude for making false entries in the account books of the company, thereby converting to his own use the sum of £900.

For Sale.—An electric lighting plant lately working at Whitson Court, near Newport, Mon., is offered for sale by tender. Particulars can be obtained from Messrs. Newland Davis & Hunt, 19, Commercial Street, Newport.

Polyphase Electric Driving.—Messrs. T. Harding Churton & Co., of Atlas Works, Leeds, have recently discarded the gas engines by which their works were formerly run, and have put down two-phase motors instead to do the work, the current being obtained from the Leeds Corporation supply mains. The motors are of Messrs Churton's own make, and are of various powers, constructed for a two-phase 200-volt, 50 ~ service. The installation has proved very successful, and the economy effected, already marked, is expected to be still further increased when the power is further sub-divided as is intended.

Information Wanted.—A correspondent wishes to know the name and address of the maker or supplier of Red Cross lubricant for commutators.

Book Received.—"Journal of the Institution of Electrical Engineers." No. 159. February, 1903. London: E. and F. W. Spon, Ltd. 5s.

ELECTRIC LIGHT AND POWER NOTES.

Abingdon.—A sum of £50 is to be spent by the Corporation E.L. Committee in obtaining expert advice on the question of electric lighting for the borough.

Benfieldside.—The U.D.C. has approached the Northern Counties Electricity Supply Co. with reference to the supply of electricity for lighting purposes to the town.

Benwell.—The U.D.C. has decided to engage an expert to advise as to the best means of carrying out the Council's prov. order for electric lighting.

Bilston.—The U.D.C. has decided to instal the electric light in the Town Hall, public offices, free library, the public market, the public baths, and the technical schools.

Bradford.—As an outcome of statements of generating costs contained in the recent paper by Mr. Chattock, the city electrical engineer, before the Leeds Section of the Institution of Electrical Engineers, the Chamber of Trades has decided to approach the Electricity Committee for the purpose of obtaining a substantial reduction in the price of energy for lighting purposes.

Brussels.—The Chambre Syndicale des Electriciens, of Brussels, is engaged upon the organisation of a permanent exhibition of electrical apparatus and motors. The plan to be adopted will be similar to that on which exhibitions for the popularisation of gas for heating and motive power are organised.

Chester.—The electric light mains are to be extended for public and private lighting, at an estimated cost of £700.

Derbyshire.—The local authorities and gas companies in the county have guaranteed £2,000 for the purpose of opposing the Bill of the Electricity and Power Gas Co. Each local authority owning gas works is to contribute £2 per million feet of gas made per annum.

Dewsbury.—The new electric tramways started running for public service on 18th inst.

Dumfries.—The T.C. has decided to approach Messrs. Crompton & Co. with a view to concluding an agreement with them for carrying out an electric lighting scheme. Messrs. Crompton had offered to carry out the whole of the works at their own cost, to pay the Council £300 down, in order to defray the cost of obtaining the prov. order, and to make an annual payment to the town of £100 during the first seven years, £200 during the second seven years, and £300 for every year thereafter. Their charges for energy are to be restricted to 6d. per unit for private lighting, 2½d. for street lamps, public offices and power, and 1½d. for tramway purposes. The Council is to have the option of purchasing the works at valuation at any time after the expiry of 15 years.

Ebbw Vale.—The U.D.C. has appointed Mr. R. P. Wilson, of Westminster, as electrical engineer for five years at £200 per annum, and has resolved to make application to the L.G.B. for permission to borrow £10,000 for an electrical scheme.

Exmouth.—The B. of T. has approved of the E.L. contract entered into by the U.D.C. with Messrs. Crompton & Co., who will pay the Council £300 down and £50 per annum.

Germany.—It is reported that the Allgemeine Electricitäts Gesellschaft, of Berlin, is preparing plans for the establishment of a large central station at Wittgensdorf, Saxony, to supply current for lighting and power purposes to the small towns in the district.

Gillingham.—The Royal Engineers' Mess has asked the U.D.C. to quote for a supply of 18,000 units per annum.

The U.D.C. has accepted tenders for the supply of machinery at its electric light works at New Brompton. It was decided to apply to the Prudential Assurance Co. for a further advance of £10,000 for extensions.

Glasgow.—The E.L. Committee has decided on extensions to its distributing system, at an estimated cost of £1,223. It is proposed to erect workshops, stores and offices in connection with Port Dundas station at an estimated cost of £6,240.

A claim has been made against the Electricity Committee by Mrs. Margaret Cooper for £1,037 11s. 5d. for damage alleged to have been sustained through a fire, which occurred in premises occupied by her. The Committee has repudiated the claim.

It is reported that the electricity revenue in Glasgow up to February was: 1902—3, £71,058, an increase of £9,343, as compared with the corresponding period of 1901—2.

The Hague.—The engineer Singels, who was requested some time ago to inquire into the matter of an electric power station for The Hague, proposes the construction of a station capable of furnishing current sufficient for 54,500 lamps immediately and 115,000 lamps later on. The cable system would embrace a length of 135 kilometres, and would comprise 66 substations with 72 transformers. In addition to lighting, the power would also be used for traction purposes. The purchase of the old system belonging to Siemens & Halske is not recommended by Mr. Singels. The cost of installation is estimated at 2,540,000 florins. The station could be combined with the refuse destructor of the town. The reporter advises that foreign firms be invited to submit tenders, but suggests that preference be given to boilers and steam engines of home manufacture.

Hanley.—The T.C. on February 18th decided to petition against the Bill of the North-Western Electricity Co., for the purpose of obtaining a *locus standi*.

Hebden Bridge.—At a public meeting held on February 18th a strong feeling was expressed that the U.D.C. should accept the offer of Halifax Corporation to supply energy in bulk at 1½d. per unit from 6 a.m. to 4 p.m., and at 2½d. per unit after the latter hour.

Huddersfield.—The Electricity Committee has presented accounts which show that the income has amounted to £23,159, as against £20,574 in the previous year, and that there is a surplus, after amounts for interest and sinking funds have been deducted, of £2,945, as against a surplus last year of £2,561.

Italy.—The municipality of Venice has granted a concession for the supply of electrical energy in the town, to an Italian company with a capital of 6,000,000 fr. (£240,000), which has been formed to utilise water power in Venetia. Extensive works are in progress at a point 56 miles distant, and will probably be completed in about two years, when some 6,000 H.P. could be supplied to Venice. If the various hydro-electrical power schemes are successful, it is thought that Italy will become to a great extent independent of foreign coal supplies for her industries.

Lancaster.—A L.G.B. inquiry has been held into the application of the Corporation to borrow £25,000 for electric lighting purposes, an additional £10,000 being authorised under the local Tramways Act. The total cost of the works has been about £70,000; electricity will be generated for lighting and tramway purposes, being sold to the Tramways Committee at 2d. per unit.

Liverpool.—The Electric Power and Lighting Committee has adopted a resolution approving the city electrical engineer's report, recommending that the minimum annual sum to be paid by consumers should be based on a consumption equivalent to 50 hours per quarter of the maximum demanded supply. Other resolutions passed by the committee are the following:—"That the price for electrical energy for lighting in the Allerton, Woolton and Childwall district be reduced as from the end of the present quarter to 4½ per unit," and "that the price for electrical energy to be charged to the Tramway Department for the current year be at the rate of 1·05d. per unit, subject to an addition at the rate of 5 per cent. for each 1s. per ton paid for coal in excess of 6s. per ton.

Llandudno.—The gross profit on the electricity works for last year was £2,882, an increase of £688.

At the last meeting of the U.D.C. letters were read from the L.G.B. sanctioning the borrowing by the Council of £1,025 for electric lighting purposes.

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Information Wanted.—A correspondent wishes to know the name and address of the maker or supplier of Red Cross lubricant for commutators.

Book Received.—"Journal of the Institution of Electrical Engineers." No. 159. February, 1903. London: E. and F. W. Spon, Ltd. 5s.

ELECTRIC LIGHT AND POWER NOTES.

Abingdon.—A sum of £50 is to be spent by the Corporation E.L. Committee in obtaining expert advice on the question of electric lighting for the borough.

Benfieldside.—The U.D.C. has approached the Northern Counties Electricity Supply Co. with reference to the supply of electricity for lighting purposes to the town.

Benwell.—The U.D.C. has decided to engage an expert to advise as to the best means of carrying out the Council's prov. order for electric lighting.

Bilston.—The U.D.C. has decided to instal the electric light in the Town Hall, public offices, free library, the public market, the public baths, and the technical schools.

Bradford.—As an outcome of statements of generating costs contained in the recent paper by Mr. Chattock, the city electrical engineer, before the Leeds Section of the Institution of Electrical Engineers, the Chamber of Trades has decided to approach the Electricity Committee for the purpose of obtaining a substantial reduction in the price of energy for lighting purposes.

Brussels.—The Chambre Syndicale des Electriciens, of Brussels, is engaged upon the organisation of a permanent exhibition of electrical apparatus and motors. The plan to be adopted will be similar to that on which exhibitions for the popularisation of gas for heating and motive power are organised.

Chester.—The electric light mains are to be extended for public and private lighting, at an estimated cost of £700.

Derbyshire.—The local authorities and gas companies in the county have guaranteed £2,000 for the purpose of opposing the Bill of the Electricity and Power Gas Co. Each local authority owning gas works is to contribute £2 per million feet of gas made per annum.

Dewsbury.—The new electric tramways started running for public service on 18th inst.

Dumfries.—The T.C. has decided to approach Messrs. Crompton & Co. with a view to concluding an agreement with them for carrying out an electric lighting scheme. Messrs. Crompton had offered to carry out the whole of the works at their own cost, to pay the Council £300 down, in order to defray the cost of obtaining the prov. order, and to make an annual payment to the town of £100 during the first seven years, £200 during the second seven years, and £300 for every year thereafter. Their charges for energy are to be restricted to 6d. per unit for private lighting, 2½d. for street lamps, public offices and power, and 1½d. for tramway purposes. The Council is to have the option of purchasing the works at valuation at any time after the expiry of 15 years.

Ebbw Vale.—The U.D.C. has appointed Mr. R. P. Wilson, of Westminster, as electrical engineer for five years at £200 per annum, and has resolved to make application to the L.G.B. for permission to borrow £10,000 for an electrical scheme.

Exmouth.—The B. of T. has approved of the E.L. contract entered into by the U.D.C. with Messrs. Crompton & Co., who will pay the Council £300 down and £50 per annum.

Germany.—It is reported that the Allgemeine Electricitäts Gesellschaft, of Berlin, is preparing plans for the establishment of a large central station at Wittgensdorf, Saxony, to supply current for lighting and power purposes to the small towns in the district.

Gillingham.—The Royal Engineers' Mess has asked the U.D.C. to quote for a supply of 18,000 units per annum.

The U.D.C. has accepted tenders for the supply of machinery at its electric light works at New Brompton. It was decided to apply to the Prudential Assurance Co. for a further advance of £10,000 for extensions.

Glasgow.—The E.L. Committee has decided on extensions to its distributing system, at an estimated cost of £1,223. It is proposed to erect workshops, stores and offices in connection with Port Dundas station at an estimated cost of £6,240.

A claim has been made against the Electricity Committee by Mrs. Margaret Cooper for £1,037 11s. 5d. for damage alleged to have been sustained through a fire, which occurred in premises occupied by her. The Committee has repudiated the claim.

It is reported that the electricity revenue in Glasgow up to February was: 1902—3, £71,058, an increase of £9,343, as compared with the corresponding period of 1901—2.

The Hague.—The engineer Singels, who was requested some time ago to inquire into the matter of an electric power station for The Hague, proposes the construction of a station capable of furnishing current sufficient for 54,500 lamps immediately and 115,000 lamps later on. The cable system would embrace a length of 135 kilometres, and would comprise 66 substations with 72 transformers. In addition to lighting, the power would also be used for traction purposes. The purchase of the old system belonging to Siemens & Halske is not recommended by Mr. Singels. The cost of installation is estimated at 2,540,000 florins. The station could be combined with the refuse destructor of the town. The reporter advises that foreign firms be invited to submit tenders, but suggests that preference be given to boilers and steam engines of home manufacture.

Hanley.—The T.C. on February 18th decided to petition against the Bill of the North-Western Electricity Co., for the purpose of obtaining a *locus standi*.

Hebden Bridge.—At a public meeting held on February 18th a strong feeling was expressed that the U.D.C. should accept the offer of Halifax Corporation to supply energy in bulk at 1½d. per unit from 6 a.m. to 4 p.m., and at 2½d. per unit after the latter hour.

Huddersfield.—The Electricity Committee has presented accounts which show that the income has amounted to £23,159, as against £20,574 in the previous year, and that there is a surplus, after amounts for interest and sinking funds have been deducted, of £2,945, as against a surplus last year of £2,561.

Italy.—The municipality of Venice has granted a concession for the supply of electrical energy in the town, to an Italian company with a capital of 6,000,000 fr. (£240,000), which has been formed to utilise water power in Venetia. Extensive works are in progress at a point 56 miles distant, and will probably be completed in about two years, when some 6,000 H.P. could be supplied to Venice. If the various hydro-electrical power schemes are successful, it is thought that Italy will become to a great extent independent of foreign coal supplies for her industries.

Lancaster.—A L.G.B. inquiry has been held into the application of the Corporation to borrow £25,000 for electric lighting purposes, an additional £10,000 being authorised under the local Tramways Act. The total cost of the works has been about £70,000; electricity will be generated for lighting and tramway purposes, being sold to the Tramways Committee at 2d. per unit.

Liverpool.—The Electric Power and Lighting Committee has adopted a resolution approving the city electrical engineer's report, recommending that the minimum annual sum to be paid by consumers should be based on a consumption equivalent to 50 hours per quarter of the maximum demanded supply. Other resolutions passed by the committee are the following:—"That the price for electrical energy for lighting in the Allerton, Woolton and Childwall district be reduced as from the end of the present quarter to 4½ per unit," and "that the price for electrical energy to be charged to the Tramway Department for the current year be at the rate of 1·05d. per unit, subject to an addition at the rate of 5 per cent. for each 1s. per ton paid for coal in excess of 6s. per ton.

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Mr. Ellis also reported that during the month of January the total units generated amounted to 386,071, as against 336,137 for December, 271,454 for November, and 237,732 for October. He, therefore, anticipated that for the 12 months ending March 31st, 1904, the total output of the Roath power station would amount to at least 6,000,000 units, and it would rank amongst the largest power stations in the country. The costs of generation showed a reduction for January over previous months, viz.: January, ·55d. per unit; December, ·58d.; November, ·63d.

Chatham.—The Parliamentary Committee of the Kent County Council has recommended the Council as the road authority to give its consent to the proposed extensions of the Chatham and District Light Railways Co.'s tramway lines from Chatham to Maidstone, Gravesend, and Rainham, on certain conditions.

Coatbridge.—On 23rd inst. the first practical step was taken in connection with the Coatbridge and Airdrie tramways when the contractors began the opening up of the streets.

Cork.—The Cork Electric Tramways and Electric Lighting Co., Ltd., proposes to enlarge its power-house to cope with the increased demand for power in the city by the Lee. The large influx of visitors to the Exhibition last year greatly increased the demand on their power, and it is expected that the Exhibition, which is to take place this year, will again do much for the tramways and lighting. The company is, however, determined to be prepared for all emergencies.

Durban (Natal).—At the Town Council meeting held here on January 27th, an interim report by the borough engineer showed that the actual expenditure upon the construction of the electric trams to date was £232,182. On the basis of the original estimate, and adding the percentage of increase in the installation, the cost per mile has been nearly £12,000, as against £10,000 originally estimated. This 20 per cent. increase he does not consider high, considering the abnormal conditions which have prevailed during the last three years in the price of materials and the increased cost of labour. On the scheme first laid down the revenue was estimated at £34,000 per annum, while to-day it is fast approaching £100,000.

The conductors and motor-men employed on the tramways are agitating for a reduction of hours and an increase of pay. At present the motor-men receive 10d. per hour for the first three months' engagement, 11d. per hour for the second three months, and 1s. after six months' experience. They ask for a uniform nine hours' day, time and a half for overtime, and double time on Sundays and holidays. The management estimate this as a 50 per cent. increase, and point out that the men are already paid at a higher rate than elsewhere in South Africa, and also have uniforms free.

The Council has passed the following resolution with reference to Indians and natives riding on trams:—"That in future, and until further notice, Indians and natives will on no account be permitted to ride on trams, except the better class of Indian traders of cleanly appearance, and decent Kaffir boys and girls in domestic service, when accompanied by their masters or mistresses."

Hammersmith, City and North London Railway.—Last Friday's *London Gazette* contains a full notice of the Parliamentary application which is being made by the promoters of the Hammersmith, City, and North-East London Electric Railway.

Lees.—As the result of an interview with the Oldham Tramways Committee, the Council has got this authority to undertake the completion of the tramway section from Leesbrook to County End, Lees. The Oldham Corporation has power to supply electricity to Lees to work the tramways, and if the present Bill which the Corporation is promoting passes, it will be able also to supply Lees with electricity for lighting purposes as well. The tramway may be completed in two months.

Liverpool.—The second annual report upon the working of the electric tramways, prepared by Mr. C. R. Bellamy, general manager of the tramways, was submitted to the Tramways Committee on Friday last. After dealing with certain of the routes, the report speaks of the action of the plough guard with which most of the Liverpool cars are now provided. A list of 21 cases is given where persons who had actually got under the platform of moving cars had been pushed clear by the plough guard, and received only minor injuries. Eight fatalities occurred, viz.:—Two to passengers, four pedestrians, one cyclist, and one linesman; but these, when worked out by the total number of passengers carried, show only one fatality to every 13,667,000 passengers. The number of personal accidents decreased by 2·05 per cent., and collisions by nearly 4 per cent., while the mileage has increased by 7·5 per cent. over 1901. On the railways of the United Kingdom the ratio of fatalities to passengers carried was one in 895,878, so that the safety of the electric car travelling public in Liverpool is 15 or 16 times as great. Particulars are given respecting the various establishments under the management of the committee, including the Lambeth Road works, where nearly 400 men are employed. During the year 3,595 cars were sent into these works for alterations and repairs, "showing that each car on the average ran for 3,306 miles before requiring attention."

During the year the total number of emergency calls in connection with the overhead equipment was 1,015, as against 2,320 in 1901. The cost of maintaining and renewing this equipment was £6,233, a decrease of 30·47 as compared with 1901. The total number of passengers carried during 1902 was 109,335,585, and the receipts were £506,728. The total mileage run was 11,790,815, and the total number of cars was 488. These figures show an increase over 1901 of 8·1 per cent. passengers, 7·5 per cent. mileage, and 8·2 per cent. receipts. The average receipts per mile were 10·34d., and per journey 7s. 4d. The football cars, however, earned 12·49d. per mile, although only an average of 5s. 2¾d. per journey. The number of cars arriving at and leaving the Pierhead on the different routes in the busy season is 5,550 per day, South Castle Street 1,070, and Old Haymarket 732, representing a total of 7,352 cars running in and out of the city per day.

The staff, on December 31st last, totalled 2,301. The electrical energy shows an increased cost of ·84d. per mile, salaries are a small fraction higher, maintenance and renewal of cars is ·770d. per mile, against ·855 in 1901, maintenance and renewal of lines is ·287d., against ·227d., equipment ·127d., against ·199d., the total working out at 6·884d. per mile, as against 6·780d. in 1901, and earnings of 10·34d. per mile in 1902. Then interest and sinking fund require 2·089d. per mile, making a total charge of 8·973d. per mile, as against 8·876d. in 1901. The capital expenditure on the system has been £1,832,977 9s. 11d., total revenue 1902, £517,935 5s., operating costs £339,810 19s. 8d., percentage of operating costs to total revenue 65 per cent.; gross profits £172,124 5s. 4d., percentage of gross profits to capital expenditure 9·7 per cent.; interest and sinking fund £102,627; balance £75,497 5s. 2d., of which £50,331 10s. 2d. goes to reserve, renewal and depreciation fund, and £25,165 15s. to general rate account. The average fare per passenger is 1·111d., the average length of penny stage 2½ miles, and the total length of track 101 miles.

Llanelly.—The T.C. on Friday decided to oppose the Tramways Bill of the South Wales Power Co., owing to the latter having refused to give the Council any protective clauses.

L.C.C.—It is stated that the Prince of Wales has promised in the name of the Sovereign to inaugurate the London County Council's system of electric tramways in South London.

Luton.—A town's meeting has requested the Corporation to re-open negotiations with the tramway company whose Bill was recently effectually opposed by the Corporation.

Manchester and Salford.—An arrangement for the working of the tramway traffic between Manchester and Salford has at last been made without the matter being referred to the Board of Trade for arbitration. A mutually satisfactory agreement has been signed and ratified. The deadlock has existed for about 18 months. Consideration for running powers, in all cases, is to be a payment based on the net profits now earned.

Metropolitan District Railway.—Mr. Perks, who presided at the meeting of the company last week, said that the work of converting the railway from steam to electricity was being actively carried on under the supervision of Mr. Chapman, their chief electrical engineer. That gentleman reported that progress was being made with the generating station at Chelsea. That power house was really the key of the whole situation. Immediately that was finished electrical trains could be run, and would be run, on the District Railway and allied lines. That work was being pushed on with the utmost possible speed, 650 men being employed upon it night and day. Two trains of seven coaches each were almost complete at the works, and the foundations had been commenced for several of the sub-stations. The bill for this work of electrification would be a heavy one. The engineer estimated that the outlay would be no less than £1,400,000, absolutely independently of the erection of the power house. Of this outlay, £300,000 represented the outlay on the road for cables, ducts, sub-stations, electrical equipment, and plant of all sorts. £600,000 represented the rolling stock which they would have to purchase. Since he became chairman of the company and the board was reconstituted, and he thought to some extent strengthened, the stocks had increased in market value by £912,000. By an agreement with the Underground Electric Co. the District agreed to issue £500,000 ordinary stock at 25; and £166,000 debenture stock, bearing 4 per cent. interest, was also issued, at par. Still, those two items together did not represent anything like the amount required. The company had power to issue £450,000 ordinary stock, for which they hoped to get a considerably better price, having regard to the fact that the quotation for that stock was now over 40, whereas at the date of the previous issue it was only 28. They also had power to issue £150,000 in additional debenture stock. The board would place as much of the ordinary stock with the Underground Electric Co. as they were disposed to take, and the more of it they could induce them to take the better it would be for the company. They were about to take powers for fresh ordinary and debenture stock. Speaking on the subject of the Royal Commission, the chairman said that the County Council had appointed a committee to watch its interests, and the District would work in close union with the Metropolitan to present their case to the best advantage. The Commissioners would, no doubt, at an early stage, decide what was to be done with regard to Bills before

Parliament. The company had deep-level schemes in hand, and if the projects before Parliament were hung up, the board might advise the proprietors to temporarily suspend that portion of the Bill.

Newcastle-on-Tyne.—At a meeting of the Tramways Committee on 20th inst, the estimates for the forthcoming year were laid before the Committee. They were based entirely on the lines now open, and do not include either income or expenditure for those to be opened during the coming year. The income was estimated at £3,150 per week, or £163,800 per annum, which would be increased by other small items to £167,650. The expenditure was put down at £1,800 per week, or £93,600 for the year; the interest and redemption of capital was put down at £43,437, and, after deducting the estimated expenses from the income, it was expected that there would be a balance of £29,914. A long discussion took place as to what amount should be put aside for depreciation and renewals. One proposal was that £21,000 should be given for that purpose, but this was contested, and £15,000 suggested. The voting was equal, but it is probable that the former sum will be eventually recommended to the Council for adoption.

Tramway Statistics. — An important Parliamentary return has been published giving in many pages of tables, a mass of particulars respecting the whole of the tramways operating in the United Kingdom at June 30th, 1902. We extract two tables showing the totals:—

TABLE SHOWING LENGTHS WORKED BY VARIOUS METHODS OF TRACTION.

Method of traction.	England and Wales.	Scotland.	Ireland.	Total.
	M. CH.	M. CH.	M. CH.	M. CH.
Electric	691 49	89 77	89 12	870 58
Steam	124 56	2 12	29 47	156 35
Cable	8 3	17 5	—	25 8
Gas motors	9 51	—	—	9 51
Horse	314 66	25 37	43 63	384 6
Mixed	37 75	—	—	37 75
Total	1,186 60	134 51	162 42	1,483 73

—	Capital expenditure on lines and works open for traffic.	Total expenditure on capital account.	Length open for traffic.			Number of undertakings.
			Double.	Single.	Total.	
	£	£	M. CH.	M. CH.	M. CH.	
Tramways belonging to Local Authorities.	14,805,859	* 18,910,467	580 8	305 32	885 40	118
Tramways belonging to *other than* Local Authorities.	10,350,677	† 12,651,800	272 53	325 60	598 33	115
Total, United Kingdom	25,156,536	31,562,267	852 61	631 12	1,483 73	233

* These figures include, in several cases, the amounts expended by the Lessees of Local Authorities on buildings and equipment for working the lines.
† These figures include cost of buildings and equipment in respect of certain Local Authorities' lines worked in conjunction with other lines.

The passengers carried during the year were as follows:—

England and Wales	1,082,192,712
Scotland	230,702,794
Ireland	81,557,477
	1,394,452,983

In the full tables such information as capital authorised and expended, and length of line is given in part I.; part II. shows the gross receipts, working expenditure, and net receipts, passengers carried, car-miles run, also numbers, engines, horses, and cars at June 30th.

Preston.—A syndicate has approached the T.C. with a view of leasing the electric tramways when constructed. It offers to pay the Corporation 5 per cent on the cost of laying the rails, and a 9-inch pavement on each side, on a 50 years' lease. The syndicate further offers to supply satisfactory overhead equipment and cars, which could be taken over by the Corporation at the end of the lease at a valuation.

Southampton.—The T.C. has applied to the B. of T. for sanction to borrow £5,950 for tramway extensions, and £835 for the electrical equipment of the Highfield route.

Southend.—The T.C. has appointed Mr. Heenan as electrical engineer of the tramways. Mr. Ward has resigned the appointment of tramways manager.

Sunderland.—At the meeting of the Tramways Committee on 19th inst., a statement of the estimated income and expenditure for the year ending March 31st, 1903, was laid before the Committee. The items of income were:—Traffic receipts, £59,240; bank interest and rents, £545; interest on investment of reserve fund, £103 13s. 3d.; and advertising, £135—a total of £60,023 13s. 3d. The expenditure is put down at £54,850, made up mainly as follows:—Electrical energy, £11,080; drivers' and conductors' wages, £10,300; management and office expenses, £1,600; inspectors, cleaners, and other staff, £5,000; rents, rates and taxes, £2,000; repairs and renewals, buildings, £100; cars, motors, and instruments, £1,850; track, rails, points and crossings, £4,300; overhead equipment, £840; interest, £7,900; sinking fund requirement, £7,300; other small items bring the total up to the sum mentioned, so that a balance is left of £5,173. The total revenue is about £2,700 more than in the previous year, but, as against this, the expenditure shows an increase of £4,543. The Committee proposes to hand over to the relief of the rates £5,000 as against £7,000 devoted to that purpose last year. The increase of expenditure is chiefly due to increases in the bill for energy, £780; depreciation, repairs, &c., £1,340; rates, &c., £621; and interest and sinking fund, £1,802.

The Tramways Committee has decided to obtain a travelling crane for use at the Silksworth Row car shed to lift disabled cars, &c. The Committee has also under consideration a scheme to have permanent signal boxes and lever-worked points.

Swansea.—It has been arranged that a conference shall take place between the Electric Light Committee and representatives of the three surface contact companies.

Taff Vale.—The Taff Vale Railway, which traverses the whole artery of the Welsh coalfield in the eastern districts of Glamorganshire, is about to experiment on the practicability of electric traction on their railway on one of their branches at no distant date. If successful they will probably adopt it on the various other branches, and ultimately on the main line of the company's system.

West Bromwich.—The section of the tramways between Carter's Green and Hill Top, which has been reconstructed and electrically equipped, was formally opened for traffic on Thursday in last week. Two sections remain to be completed, these being Spon Lane and Bromford Lane.

TELEGRAPH AND TELEPHONE NOTES.

Brussels—Metz Telephone.—The negotiations between the Belgian Administration and the Direction of Posts and Telegraphs of Alsace-Lorraine for the establishment of a direct line of telephone between Metz and Brussels are advancing rapidly.

Electric Railway Signalling.—The *Standard* says that experiments were carried out the other day on a section of the French State Railway between Chénu and Chateau la Vallière, in the Sarthe Department, with a system of automatic electric signalling, destined, according to the claims of its inventor, to reduce the possibility of collision between railway trains to a minimum. The system is the invention of a Spanish engineer, Senor Basanta. It consists of the application of the telephone to railway trains. Upon each of the trains used a modified telephone receiver and transmitter is fitted. A shoe or trolley trails along a special wire which has to be fitted along the track. As with the block system, the line is divided into sections, and at each section end, which may be a railway station or signal-box, there are fitted special telephone transmitters and receivers. By these means it is possible for the persons in charge of either the signal-box or the station to at any moment enter into communication with the driver or guard of the train, or *vice versâ*. If a second train gets on any section before the first train has left it, alarm bells ring upon both trains. One or both of the trains can then pull up, and a conversation as to the course to be adopted can be held between the two! Experts admitted that it was ingenious, and might be a useful adjunct to the block system; but owing to the apparent delicacy of several of its principal parts, there were few who would admit that it was a system which could be depended upon alone.

Somaliland Telegraphs. — Reuter's representative at Berbera says that telegraphic communication has been established to Burao, a distance of 85 miles. On the 15th inst. mischief-makers cut the telegraph line and pulled up the poles 20 miles from Berbera.

The Steljes Type-printing Telegraph.—The Typewriting Telegraph Corporation, Ltd., of Queen Victoria Street, has received a command from the Minister of War for Austria, and its general manager has proceeded to Vienna, with a staff of engineers, to make demonstrations there, similar to those made at Berlin in October last.

Telegraphic Communication with Borneo.—We read in the *Times* that to-morrow, on the invitation of the directors of the Eastern Extension Telegraph Co., the Lord Mayor will attend a luncheon to be given on board their new cable ships, the *Restorer* and the *Patrol*, now at Gravesend. These are laden with a cable to be laid between Celebes and Balikpapan, Borneo, for the Dutch Government.

Trunk Telephone Messages at Night.—With a view to promoting a more extended use of the trunk wires during the night, the Postmaster-General has decided to allow a double period of conversation—*i.e.*, six minutes—between 8 p.m. and 6 a.m. for the same fee as is charged for a single period of three minutes during the day. The new arrangement will come into operation on March 1st.

Wakefield Telephones.—The T.C. has abandoned the question of establishing municipal telephones for the city.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1900	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
St. Lucia-St. Vincent	Nov. 18, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiros	Aug. 13, 1902	
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902	
Cadiz-Teneriff	Nov. 8, 1902	
St. Jacques-Haiiphong	Jan. 3, 1903	
Jamaica-Colon	Dec. 31, 1902	
Sitoebondo-Bandjermasin	Jan. 26, 1903	
Marseilles-Barcelona	Jan. 28, 1903	Feb. 22.
Landlines :—		
Route to Tientsin and Taku *via* Helampo	June 18, 1900	

Wireless Telegraphy.—The Mexican Government is adopting wireless telegraphy across the Gulf of California, the receiving stations being respectively at Cape Haro, near Guaymas, Mexico, and Santa Rosalia, Lower California.

In the Commons on 19th inst. Mr. Herbert Samuel asked the Postmaster-General whether facilities would be given to the public, through the General Post Office, for the transmission of messages by wireless telegraphy to the Continent of America and elsewhere. Mr. Austen Chamberlain replied as follows:—"The effect of recent progess in the development of wireless telegraphy upon both the commercial and strategic interests of this country is now receiving the careful consideration of his Majesty's Government. I am also in communication with the Marconi Wireless Telegraph Co. upon the subject of their relations with the Post Office. I am not at present in a position to make any final statement upon the subject, but I have no doubt that it will be possible to secure for the public of this country the use of this method of communication when it is sufficiently developed for commercial purposes."

Mr. Marconi was the guest of the Savage Club at the house dinner on Saturday last, Mr. J. Henniker-Heaton, M.P., presiding. Mr. Marconi, in response to the toast of his health, said that about six years ago the system with which his name was associated was worked for a distance of about two miles, which was then considered a wonderful achievement. In 1899 this system of transmitting intelligence through space was developed sufficiently to enable installations to be erected on both sides of the English Channel, and messages were sent between England and France. At that time great doubt existed whether the system was capable of further development or not. Those interested in the cable companies asserted that owing to the curvature of the earth it would be impossible to transmit wireless messages for considerable distances, and that in order to do so between England and America it would be necessary to erect towers 200 miles high! He had not, however, found this to be necessary, and communication had been established between Canada and England and between the United States and England with a height no greater than that used in 1899 across the English Channel. His system had established communication with stations on both sides of the Atlantic, which communication not only was valuable to passengers, but in some instances had been serviceable to the safety of ships. The land stations on both sides of the Atlantic could be spoken for a distance of 200 miles, but he confidently hoped to increase that distance very considerably shortly. He felt bound to acknowledge the great encouragement King Edward had already given him. As early as 1898 his Majesty had lent him the Royal yacht *Osborne* for three weeks at a time for his experiments. The British Government had to be very cautious what steps they took, as this subject was one affecting the whole Empire; he sympathised with that caution, but as half a Britisher himself, he should be sorry if the result of that policy was that every Continental nation should reap the advantages of this system of wireless communication before England. He sincerely hoped that their deliberations would come to a conclusion soon.

A Press despatch from Rome, dated February 20th, says that on that day, the Italian Chamber passed the Bill for the construction of an extra powerful radio-telegraphic station on the Marconi system for the purpose of communicating with a similar station in a South American Republic and with the stations already existing and any others that may come into existence. Signor Galimberti, Minister of Posts and Telegraphs, stated that Signor Marconi intended to make the Italian radiographic station a centre for wireless telegraphic communications throughout the world.

The Report of the French Budget Sub-Committee on Posts and Telegraphs prepared by M. Marcel Sembat, and just issued to Deputies, contains the following references to wireless telegraphy:—"Wireless telegraphy has doubtless a great future, but no important improvement in this new system of transmission has been reported by the French administration. The means of rendering wireless messages, exchanged between various stations, independent of one another has not yet been found. It is sufficient for us in this connection to reproduce the conclusion of a recently-published work by two engineer officers, Commandant Boulanger and Captain Ferrié, who have specially interested themselves in this question. Communications by wireless telegraphy give no security, for, in the present conditions, a receiver cannot be protected against atmospheric influences, nor against an energetic tranmission made even at a considerable distance, by a station other than that with which it is wished to correspond. It is impossible to forecast, at present, the means of remedying this inconvenience. The applications of wireless telegraphy can only be limited, and they cannot replace the methods of communication employed up to the present in military telegraphy. The experiments which have been accomplished by means of syntonised stations lead us to believe that syntonisation contributes towards augmenting the range of the apparatus, and weakens the foreign transmissions beyond a certain distance, without completely suppressing them. Progress has therefore only taken place as regards the distances traversed. On the coast of France a range of 120 kilometres has been attained without syntonisation, and 250 kilometres with syntonisation. Thus it has been possible to establish communication between Belle-Isle and the point of La Courbre at the mouth of the Gironde. The distance between these two points is 250 kilometres. In the same way it has been possible to communicate from Villeneuve St. George to Chablis, separated from the first point by 150 kilometres. Here the distance is less than in the preceding case. Nobody is ignorant of the fact that the exchange of wireless telegrams is more difficult on land than by sea, the smallest accident on land weakening the Hertzian waves. It has been remarked, in a precise manner, that these waves are transmitted more distinctly if the transmitting station and the receiving station are placed before a sheet of water of some extent. Recently attempts have been made abroad to communicate over distances larger than those indicated above. Thus, for example, an attempt has been made to establish communication between the cruiser *Carlo Alberto* in the Mediterranean and the Marconi station at Poldhu, Cornwall. To sum up, it seems that the augmentation of the strength of the currents used will increase the range of transmission, but so long as the means of ensuring the secrecy of the correspondence exchanged remains undiscovered, and no remedy has been found for the difficulties arising from the superposition of signals and atmospheric disturbances, this means of transmission cannot supersede the means of transmission employed up to the present day. The first service which this new application of science can render in its present condition consists in the possible exchange of communications between the coast and vessels at sea, or neighbouring islands, or between the vessels themselves."

The Argentine Government proposes to establish Marconi wireless telegraph stations at Cape Virgenes and Ushuaia, in order to obtain advance news of the arrival of steamers.

Signor Marconi had a private conference with the Postmaster-General on Tuesday.

According to the *Westminster Gazette* of the 25th inst., the Lodge-Muirhead system of wireless telegraphy has recently passed through severe tests, with admirable results. The coherer is of a new type, self-decohering, and is used directly in conjunction with a siphon recorder. The transmitter requires only a comparatively short mast. Satisfactory trials have also been carried out at sea.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 14th. Twelve double-deck tramcars. See "Official Notices" to-day.

Austria.—March 10th. As stated last week tenders are being invited by the Austrian State Railway authorities at Lemberg for complete plant for the electric lighting of the railway station at Lemberg.

Barking.—March 20th. Overhead equipment, poles, feeder cables, &c. See "Official Notices" February 13th.

Battersea.—March 2nd. Coal, stores, carbons and meters. See "Official Notices" February 13th.

Battersea.—March 10th. One 300—350-KW. steam dynamo, &c. See "Official Notices" February 20th.

Belgium.—March 5th. Tenders are being invited until March 5th by the municipal authorities of Ghent, for the concession for the electric lighting of the town. Tenders are to be sent to L'Hotel de Vil'e, Ghent, whence particulars may be obtained.

Belgium.—Tenders have just been invited for the concession for the public and private electric lighting of the town of Lodelinsart.

Bermondsey.—March 2nd. Carbons, electricity meters, indicators, fuses, oil, incandescent lamps, cables, stores, &c., for 12 months. See "Official Notices" February 13th.

Bilston.—March 16th. Wiring and fittings for public buildings. See "Official Notices" February 20th.

Brighton.—March 9th. Feeder, distributing and telephone cables. See "Official Notices" to-day.

Bury.—February 27th. Tramway poles, overhead line, section boxes, &c. See "Official Notices" February 13th.

Bury.—March 6th. Traction switchboard and accessories. See "Official Notices" February 20th.

Chester.—February 28th. 150 electricity meters. See "Official Notices" February 13th.

Darlington.—March 20th. Eight double-deck and eight single-deck tramcars, with equipment. See "Official Notices" to-day.

Edinburgh.—March 16th. Telephone installation at Clinton Mains Hospital. See "Official Notices" to-day.

France.—March 5th. As stated last week the French Post and Telegraph authorities in Paris are inviting tenders for 110 tons of bronze wire, and 1,500 tons of copper wire.

Harrogate.—March 5th. 12-B.H.P. alternate current (single-phase) motor. See "Official Notices" to-day.

Holyhead.—March 4th. A complete electric lighting plant for the U.D.C. See "Official Notices" February 20th.

Hornsey.—March 16th. Cables and stores. See "Official Notices" to-day.

Koloszvar (Austro-Hungary). — March 10th. As already stated the Municipal authorities are prepared to consider tenders for the installation of an electric power station.

L.C.C. — March 17th. 200 tramcars, complete with trucks, motors, controllers, &c. (100 bogie and 100 single truck). See "Official Notices" February 20th.

L.C.C.—March 24th. Traction switchboards to be erected at Deptford. See "Official Notices" to-day.

Manchester.—March 5th. The Electricity Committee wants tenders for wiring nine sub-stations.

Plymouth.—March 15th. Meters, transformers and cables. See "Official Notices" to-day.

Portsmouth.—March 6th. Lancashire boilers, steel chimney, fan and engine for induced draught, piping, &c. See "Official Notices" February 20th.

Rhyl.—March 16th. Carbons and meters. See "Official Notices" to-day.

St. Annes-on-Sea. — March 4th. Cables and extensions to induced draught plant. See "Official Notices" Feb. 20th.

St. Pancras.—March 5th. 200 arc lamp columns and 200 arc lamps. See "Official Notices" to-day.

Salford.—March 14th. Cables, meters, fittings, carbons, motors, conduits, stores, &c., for 12 months. See "Official Notices" to-day.

Stockport.—February 28th. The Tramways Committee invites tenders for laying permanent way of the electric tramways.

Sunderland. — February 27th. Surface condenser, induced draught fan, battery and booster, and piping. See "Official Notices" February 6th.

Sunderland.—March 27th. Annual supply of I.R. covered cables and stoneware casings; one fuel economiser. See "Official Notices" to-day.

Wakefield.—March 2nd. Feeders and conduit. See "Official Notices" February 20th.

Warrington.—March 4th. Water-tube boilers and pipework, two 750-KW. steam dynamos, switchboard extensions. See "Official Notices" February 6th.

Wednesbury.—March 28th. Motor-generators, boosters, accumulators, switchboards, cables, &c., and street work, meters, indicators, fuses, &c. See "Official Notices" to-day.

Withington.—February 28th. U.D.C. wants tenders for electric lighting of sewage works. Mr. A. H. Mountain, engineer, Town Hall, West Didsbury.

CLOSED.

Bootle.—The Corporation has placed an order for Dialite cables with the St. Helens Cable Co.

Bradford. — The Electricity Works Committee has decided to accept the tenders of Messrs. Musgrave, Ltd., of Bolton, for one 2,000-H.P. engine, and the tender of Messrs. Cole, Marchent and Morley, Ltd., of Bradford, for another engine of similar power. The cost of the engines will be £7,000 each.

Dartford.—The U.D.C. has accepted the tender of Messrs. S. W. Gibson & Co., of Dartford, for the wiring of consumers' premises in the district.

L.C.C. — The Highways Committee recommended the Council to accept the offer of Dick, Kerr & Co., to supply 20 additional cars for £11,200 for use between Camberwell Green *via* Camberwell New Road to Westminster and Blackfriars Bridges during the reconstruction of the lines between the Elephant and Camberwell Green.

Maidstone.—Messrs. R. Carr & Co. are to supply 1,300 yards of cast-iron troughing required for the new extensions of the electricity system.

Salford.—The tender of the Lancashire Dynamo and Motor Co., for two sets of reversible boosters has been accepted.

Shoreditch.—The Borough Electricity Committee has accepted the tender of Messrs. Rowland Carr & Co. for cast-iron arc lamp columns.

Southampton.—The T.C. has accepted the tender of Messrs. Walter Scott, Ltd., for the supply of 320 tons of rails and fishplates for the Highfield and Old Portswood tramway extension.

Wallasey.—The tender of the Lancashire Dynamo and Motor Co., Ltd., for a 500-KW. set with Browett-Lindley engine has been accepted.

Wellington (N.Z.).—Messrs. Macartney, McElroy and Co. have received the T.C.'s contract for the electric tramways at £115,000. It is also said that a British firm is to carry out the power station contract.

FORTHCOMING EVENTS.

Friday, February 27th.—At 3 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Board of Trade Electrical Standards Laboratory.

At 8 p.m. Electro-Harmonic Concert (Ladies' night). See "Notes" columns.

Saturday, February 28th.—The annual Corps dinner of the Electrical Engineer Volunteers at the Trocadero Restaurant has now been postponed.

Monday, March 2nd.—At 7.30 p.m. Institution of Electrical Engineers (Newcastle). Lecture by Mr. T. M'Clague on "Apparatus for X Ray and other High Tension Electric Work."

At 8 p.m. Society of Arts. Cantor Lecture No. 1, "Hertzian Wave Telegraphy in Theory and Practice," by Prof. J. A. Fleming.

At 7.30 p.m. Society of Engineers. Royal United Service Institution. "Road Traffic in and near Large Cities," by W. Worby Beaumont.

Tuesday, March 3rd.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Owen's College. Paper by E. W. Cowan and L. Andrews on "The Arrangement and Control of Long-Distance Transmission Lines."

At 8 p.m. Institution of Civil Engineers. Paper to be further discussed: "Mechanical Handling of Material," by G. F. Zimmer.

Wednesday, March 4th.—At 7.30 p.m. Institution of Electrical Engineers (Students' Section). "Turbo-Generators for Central Stations," by G. J. D. Scott.

Thursday, March 5th.—At 8.30 p.m. Röntgen Society. Paper on "Spark Phenomena," by F. H. Glew.

At 8 p.m. Civil and Mechanical Engineers' Society. Caxton Hall. R. W. A. Brewer on "The Production of Power by means of Gas Producers and Engines."

Friday, March 6th.—At 7.15 p.m. Institution of Electrical Engineers (Manchester). Annual Dinner at Grand Hotel.

At 7.45 p.m. B.E.T. Club Grand Bohemian Concert at the Freemasons' Tavern, Gt. Queen Street, High Holborn, W.C.

At 8 p.m. Junior Institution of Engineers. Westminster Palace Hotel. Paper on "Practical Notes on the Use and Maintenance of Electric Motors for Factory Work," by W. T. George.

Saturday, March 7th.—At 7.30 p.m. Glasgow Technical College Scientific Society. J. Menmuir on "Low Pressure Switch Gear."

Monday, March 9th.—At 8 p.m. Institute of Marine Engineers. Paper on "Cylindrical Multitubular Boilers," by E. Nicholl.

Tuesday, March 10th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Glasgow Royal Infirmary. Visit to the new Electrical Pavilion, and Demonstration by Dr. John MacIntyre.

Wednesday, March 11th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham). The University.

At 8 p.m. Association of Engineers-in-charge. St. Bride Foundation Institute. "High Speed Engines," by W. Crawford.

Thursday, March 12th.—Students' Engineering and Metallurgical Society. Sheffield University. W. F. Mylan on "Accumulators."

NOTES.

The Air of the London Underground Railways.—A report has recently been issued by the Public Health Committee of the London County Council upon the chemical and bacteriological condition of the atmosphere in the Central London and South London electric railways. The highest proportion of carbon dioxide found in the C.L.R. was 14·7 volumes per 10,000 in a non-smoking carriage, and the smallest 9·6 volumes in an empty carriage; while on one occasion the lifts at Oxford Circus gave 15·2 volumes. About 78 per cent. of the samples tested contained more than twice as much carbon dioxide as the outside air, 66 per cent. containing more than 2½ times as much. Samples collected at midnight and before resumption of traffic indicate that the nocturnal ventilation of the tube is fairly satisfactory. At the London Bridge station of the City and South London Railway, 7·6 parts of carbon dioxide were met with; in an empty carriage, 14·1 parts; in an empty carriage on the Metropolitan Railway between Edgware Road and Portland Road stations, 16·0; ditto between Baker Street and Gower Street, 28·8; in an empty carriage on the District Railway between Mansion House and Temple stations, 15·1 parts per 10,000. Dr. Andrewes has bacteriologically examined 12 samples taken from the C.L.R. He finds the air to contain on an average 1·3 times as many micro-organisms as the outside atmosphere; but the excess is made up of non-pathogenic sarcinæ and allied species, specific disease-bearing organisms being absent. The passages and platforms of the C.L.R. are better in respect of bacterial impurity than the atmosphere, and there is a direct correspondence between the amount and concentration of human traffic and the number of organisms in the air. It would be interesting to hear Dr. Clowes's explanation of the higher proportion of carbon dioxide in a non-smoking carriage, if both "smoker" and "non-smoker" were tested when equally full of passengers.

Ethereal Dreams.—The *Westminster Gazette* is of a guileless, trusting disposition, and has often been cruelly ill-used by enthusiastic visionaries. We have seldom, however, seen our contemporary carried so far beyond the clouds as it was on Tuesday last. A Mr. Thomas H. Williams, A.M.I.C.E., had been interviewed by one of the *Westminster* Peter Simples, whom he assured that he had "managed to collect etheric waves in sufficient quantity to enable a small motor to be operated without any other (*sic*) source of power." The inventor, nevertheless, went on to state that the source of power in his experiments was a "high-frequency alternating electric generator, from which the energy was discharged into space." "The model car was provided with a collector, by means of which the etheric waves or rays were picked up." Naturally, the inventor hinted that to demonstrate the commercial value of his invention would involve a greater outlay than he was prepared to meet—they all say that. The conversation touched upon main line railway working, penny-in-the-slot motor-cars (the slot being carried on the car), aerial navigation, the possible inconvenience of having the highways and byways of the country always "heavily charged with electricity," Tesla's high frequency experiments, and other matters of grave import. Why did the inimitable F. C. G. miss the chance of depicting a motor-car with a pole 150 ft. high (suitably guyed) collecting "etheric force" at the top, and a slot collecting filthy lucre at the bottom?

Old Students' Association Dinner.—A well-attended gathering of the old students of the Central Technical College, and their friends, took place on Friday last at the Trocadero, on the occasion of the fifth annual dinner of the Association, Prof. Unwin, Dean of the College, being in the chair.

After the loyal toast had been duly honoured, Mr. J. Swinburne, President Inst.E.E., proposed the "College and Staff," referring to the value of a sound theoretical training for engineers, and to the vast amount of fundamental work, especially in electricity, which the present staff had done. Prof. Ayrton, in replying, drew attention to the valuable work done by old students, mentioning in particular the oscillograph.

The "Old Students' Association" was proposed by Prof. Unwin, who showed how old students of the College are now distributed all over the globe, and laid stress on the great value of the Association in keeping them in touch with one another. Mr. H. A. Humphrey, one of the original students, in replying, stated that each subject he had studied at the College had in its turn proved of the greatest value to him, and expressed his gratitude to the professors; while Dr. Williamson showed how valuable the spirit of research taught at the College was in after life, each piece of work which came to a scientific expert being in reality a piece of research.

Dr. E. F. Armstrong, the secretary of the Association, reported on its present position, stating in particular that over 1,000 students had passed through the College, and that 300 students were at present attending the regular course.

Dr. Sumpner, F.C.G.I., Principal of the Birmingham School of Technology, emphasised the importance of the connection of the College with the University of London, and Dr. Frank Heath, the Academic Registrar, replied.

Business Automobiles.—A lecture was delivered at the Automobile Club of America on January 27th, by Mr. Hayden Eames, of the Westinghouse automobile department, on progress in the introduction of business automobiles. In a summary the *Electrical World* says that Mr. Eames has been in the closest contact with the art for several years past, and his utterances have an authority of no slight weight. The electric vehicle was considered almost exclusively, and the statement was made that almost the only obstacle to the progress of the electric business vehicle was that many business men would not subject a motor vehicle to a test under the same conditions of operation as their horse-drawn vehicles, but insisted upon unpractical requirements regarding mileage, &c. It was stated that careful experiments by a leading firm of makers of electrical vehicles which were made in New York City and the vicinity showed the most difficult route in the entire city, which, as operated by a local express company, required three wagons and 21 horses, to be 11 miles in extent, reaching from the Grand Central Station to a point in Brooklyn. This route could be covered by a single motor vehicle at much less expense, the annual saving being sufficient to pay for charging plant at both ends. Another interesting comparison was made from the actual results of a year's trial of an electric vehicle for express work in Pittsburg, where the annual expense was $1,998, as against $3,469.40 for horse service, showing an annual difference of $1,471.40. Mr. Eames also said he knew of two cases where large orders for electric vehicles had been given, one for 700, and the other for 200, neither of which could be filled. In moving a vote of thanks on behalf of the club, Mr. T. C. Martin expressed the conviction that the topic under consideration was one of the most important that automobilists could discuss. The bicycle had ceased altogether to be a luxury or a fad. It had shrunk to the proportions of necessity, and was more or less a beast of burden. To-day saw the boom of the "auto," but he believed that, while there was a larger future for the pleasure automobile than for the bicycle, the boom and the profits would shrink; and then, in time, automobile builders would find their largest opportunity in business vehicles. Of this class he considered that the electric in cities had the brightest prospects, and as supplementing Mr. Eames's figures, he pointed out that the cost of electric service was always and steadily diminishing. In fact, about the only two things in the last two years that were cheaper in New York City were electric current from the Edison mains and the telephone service. As for gasoline, there was little reason to expect that to get cheaper, and he hardly thought steam was in the race at all.

Technical Education in America.—The Principal of the Northampton Institute, London, Dr. R. Mullineux Walmsley, is being sent on a three months' tour to the United States and Canada for the purpose of investigating the present position of technical education in those countries, and its bearings upon industrial production, in the subjects covered by the technological work of the Institute, but more especially in the engineering industries.

London County Council—General Powers Bill.—We learn that the agitation of the London Electrical Contractors' Association against the proposals of the L.C.C. in their General Powers Bill is meeting with considerable support. The undermentioned members of Parliament have intimated their opposition to the L.C.C. proposals, and the list is being added to daily:—Earl Percy; The Rt. Hon. Lord Windsor, P.C.; The Rt. Hon. Lord Avebury, P.C.; Lord Claud Hamilton; Sir Wm. E. Tomlinson, Bart., M.P.; Sir A. Henderson, Bart, M.P.; Sir Thos. Wrightson, Bart., M.P.; Sir Geo. Fardell, M.P.; Sir H. S. King, M.P.; The Hon. Alban G. H. Gibbs, M.P.; The Hon. Humphrey Sturt, M.P.; The Hon. Vicary Gibbs, M.P.; Col. Legge, M.P.; Major Banes, M.P.; Sir Fredk. Banbury, M.P.; Mr. Irwin Cox, M.P.; Lord Ebury; Major Kenneth R. Balfour, M.P.; Major Rasch, M.P.; Major Wyndham Quinn, M.P.; Capt. H. M. Jessel, M.P.; Capt. C. B. Balfour, M.P.; and Messrs. B. J. Cohen, M.P.; R. W. Perks, M.P.; E. M. Bousfield, M.P.; Alf. Baldwin, M.P.; E. Boulnois, M.P.; Walter Rothschild, M.P.; Evelyn Cecil, M.P.; E. Walter Greene, M.P.; A. G. Boscawen, M.P.; Henry Kimber, M.P.; D. J. Morgan, M.P.; E. A. P. Moon, M.P.

Charing Cross and Strand Electricity Supply Corporation, Ltd.—On Saturday evening last the cricket club of this very pushing corporation held its annual Bohemian concert at the Freemasons' Tavern, Great Queen Street, W.C. This is the second function of this kind, and proved a complete success. Mr. John Gatti (one of the corporation's directors) was in the chair, and presided over a large and appreciative audience, about 450 being present. An excellent programme of music and comedy was discoursed, and the chairman presented the prizes gained during the last cricket season. In a speech sparkling with subdued wit and humour, he eulogised the organiser of the concert, and dwelt upon his indefatigable energies in having raised the club from penury to comparative affluence, and on behalf of its members presented him with a silver cigarette case as a token of their esteem and good fellowship. Many kind wishes were expressed for the future of the club, and considerable support was promised for the forthcoming season. The secretary of the club will be pleased to receive any challenges from kindred teams at 60, St. Martin's Lane, W.C.

Tramways and Light Railways Association.—Mr. L. A. Atherley-Jones, K.C., M.P., presided over the general meeting of this Association, held at Westminster on February 19th. In the report, the adoption of which the chairman moved, the Council expressed regret that no sensible progress had as yet been made in abating or removing those restrictions which prevented the free development of tramway enterprise. The membership of the Association had increased by 30 per cent. during the past year. Mr. W. M. Murphy, the vice-president, seconded the motion, which was adopted. The chairman alluded with regret to the retirement from the presidency of Sir Charles Rivers Wilson, who, he stated, had consented to remain a member of the Council.

London County Council.—The Council decided at the meeting on Tuesday to sanction the borrowing by the Islington B.C. of £895 for electric lighting purposes, and to advance £1,800 to the West London District School managers for the electric lighting of the school at Ashford.

It was decided to approve an estimate of £32,000 for the reconstruction of the car sheds at Camberwell to adapt them for electric tramcars, this amount covering the cost of the track work and electrical equipment inside the sheds; and to sanction an outlay of £21,100 for the erection of sub-stations and workshops at New Cross and Camberwell.

The consideration was adjourned for a week of a report by the Highways Committee, which recommended the Council to approve an estimate of £278,800 for the construction of the tramways subway authorised between Southampton Row and the Victoria Embankment.

Electric Power Developments in Switzerland.—Dr. R. Lorenz has contributed to a recent issue of the *Zeits. f. Elektrochemie* a review of the position of the electrical power generating stations and transmission lines in operation in Switzerland at the end of 1901. This article is based upon a remarkable map drawn by Dr. Wyssling, of the Zurich Polytechnic, and printed and published by H. Kummerly & Frey, of Berne. The map measures 70 cm. × 50 cm., and in it the position of all the public and private generating stations and the transmission lines in operation in Switzerland at the date named above are marked in red. A reproduction of this map on a reduced scale is printed in the *Zeits. f. Elektrochemie*, containing Dr. Lorenz's article. The reproduction resembles nothing so much as a railway map of Central England, or the Eastern States of America, and it is a striking proof of the extent to which the natural resources of Switzerland are now being utilised for the benefit of the country. Doubtless in ten years' time a map of the northern counties of this country constructed on the same plan will show a similar network of high-pressure transmission lines; but we prefer not to speculate as to what the corresponding map of Switzerland will then resemble. The total power available in the waterfalls of the country must be enormous, and at present not one-hundredth part of it is developed and utilised.

As regards the total power at present developed, and the use made of it, the following aggregates are given by Dr. Lorenz:—*Total Power Generated*, 111,000 KW. *Water Power*, 97,600 KW. in public installations, 7,300 KW. in private installations; *Steam Power*, 3,100 KW. in public installations, 200 KW. in private installations; *Gas and Oil*, 2,700 KW. The power is utilised chiefly for motive power and lighting, 63 per cent. of the total generated being employed for these purposes; 13 per cent. is used for Electric Railways, and the remaining 24 per cent. in the Electro-chemical Industries. The more important installations of power for Electro-chemical purposes are stated by Dr. Lorenz to be the following:—Aluminium Industrie, Neuhausen, 4,000 H.P.; Aluminium Industrie, Rheinfelden, 7,000 H.P.; Soc. d'Electrochemie, Vallorbes, 7,300 H.P.; Soc. Anonyme Suisse Volta, 2,000 H.P.; Société des Usines de Monthey, 2,000 H.P.; Gesell. f. El. Chemische Industrie. Bern, Thusis, Luterbach, 6,000 H.P.; Usines Electriques de Lonza, 6,000 H.P.; Carbid Fabrik Flums, 3,000 H.P.; Carbid Fabrik Gurtnellan, 3,500 H.P. Dr. Lorenz states that these totals in many cases are the maximum power obtained during the spring-floods, and that the majority of the Carbide works are at present shut down, owing to the depression in the Calcium Carbide Industry. Electro-chemists and Electro-metallurgists with new processes, ready for trial on an industrial scale, should therefore betake themselves to Switzerland, where there ought to be little difficulty at present in obtaining the necessary supply of electric power at remarkably low rates.

Morse's Prophecy.—The *Electrical Review*, New York, has recently published extracts from a journal kept by Samuel F. B. Morse, now possessed by Thomas A. Edison. One of the letters printed in this journal contains the inventor's prophecy of trans-oceanic telegraphy written in 1843. In his position as superintendent of electric magnetic telegraphs, Mr. Morse reported to the secretary of the U.S. Treasury the result of the experiment made with the prepared wire in one continuous line of 160 miles. He says:—"Some careful experiments on the decomposing power at various distances were made from which the law of propulsion has been deduced, verifying the results of Ohm and those which I made in the summer of 1842 and alluded to in my letter to the Hon. C. G. Firris, published in the House Report No. 17 of the last Congress. The practical inference from this law is that a telegraphic communication on my plan may with certainty be established across the Atlantic! Startling as this may seem now, the time will come when this project will be realised. The wire is now in its last process of preparation for enclosing in the lead pipe, which will be commenced on Tuesday, the 15th inst."

University College, London, Past Engineering Students.—We understand from the hon. sec., Mr. P. T. J. Estler, of 25, Laurence Pountney Lane, E.C., that the seventh annual dinner takes place at the Criterion Restaurant on Thursday, March 12th, at 7.30 p.m. It is hoped that many old students whose addresses are not known to the secretary, and therefore have not received previous notification, will endeavour to be present at the annual dinner. Prof. J. D. Cormack will take the chair, and Dr. A. B. W. Kennedy, F.R.S., has also promised to be present. The annual meetings of Past U.C.L. Students have always been very successful, and it is hoped that this notice will induce many to be present who have lost touch with their old fellow students.

New Cut-out and Joint-box.—The following letter was too late for insertion in our "Correspondence" columns:—

"My attention has been called to the comments in your last issue on a new cut-out and joint-box manufactured under my patents by Mr. R. Falshaw, electrical engineer, of this town.

"I do not know what special qualifications and practical experience your critic has which fit him for passing judgment on such devices, but his statements are so misleading and at variance with actual facts, that they are calculated to do serious and unmerited damage to Mr. Falshaw's business.

"First, as to the cut-out. This has not been put upon the market until its utility and reliability have been thoroughly tested in every-day use for over 12 months, and of the hundreds in use and at work under all possible conditions not one single fault or failure has occurred.

"The 'Thackray washer' method of maintaining the various parts exerts a continuous thrust on all the electrical connections of over 2 cwt., and the contacts cannot be impaired by vibration or other causes, as is so frequently the case with connections made under screw heads, while the surface bearing of the connections between the washers is at least 10 times that usually obtained under screw heads. This fact, and the heavy metallic parts used, render all these connections safe with any current up to 250 amperes. I have yet to come across a cut-out box of the ordinary screw contact type which will stand such a heavy current without undue heating.

"Further, there is found to be no 'diffusion of considerable energy in practical work,' as there is an unusual amount of insulating surface of porcelain provided between the live contacts, and the box is specially designed for filling up with insulating compound till the whole of the connections are buried therein, and the insulation is then safe for any pressure up to 2,000 volts.

"Your surmise that 'the fuses may be too near together and to the sides of the box' is not correct, as the fuses have been blown, when under test on a dead-short circuit, at a pressure of 400 volts, and this when fitted with 1/30s. copper fuse wire.

"Your adverse comments on the joint box are equally unmerited. The first 'possible bad joint' has yet to be discovered, though many of these boxes have been on cables in wet ground for months.

"As to the relative merits of bolts and nuts *versus* galvanised iron binding wire for binding the outer cast-iron cases together, every jointer knows that once a joint box is filled up solid with insulating compound, it is well-nigh impossible to separate the two halves of the outer casing without breaking them, unless the compound is first warmed by the application of a blow-pipe, or other means. Hence, when a box is jointed, filled and buried, neither bolts nor binding wire upon the outer casing is necessary.

"Many a well-made electrical joint underground has 'gone wrong' because air has become imprisoned in the interior of the box during the process of pouring in the hot compound, thus preventing the said compound from entirely and effectually enveloping the connections. Again, joints have often proved faulty after being in use for varying periods, owing to the imperfect adhesion between the compound and the dirty lead tube with which the cable is covered.

"These two fertile sources of trouble in joints are impossible in the joint box which you so readily condemn, and it does not conform to your obvious suggestion that it is "cheap and nasty."

"Believing as I do in your journal's reputation for fair play and honesty of purpose, I ask that you will be good enough, in justice to myself and the manufacturer, to publish this letter in your next issue.

"GEO. WILKINSON.

"Harrogate, *February 24th*, 1903."

[We regret that our criticism should have left an impression of injustice or unfairness upon our correspondent, and we are glad to publish his statements as to the reliability of his cut-out box during a 12 months' test. We may point out that the margin between the possible and probable occasionally vanishes, with costly results, and it should be the aim of the designer to keep this margin a safe one—beyond the possibility of failure. In order to remedy any false impression as to the popularity of Mr. Wilkinson's inventions, we shall be pleased to publish a statement of the number of boxes which have been sold and the period during which they have been in use at various towns. With reference to Mr. Wilkinson's innuendoes as to the qualifications of our staff to appraise the merits of electrical appliances, it may interest him to learn that we have had practical experience in the working of some of the most important municipal supply and power transmission schemes in the kingdom. For the rest, Mr. Falshaw is surely capable of looking after his own business without the assistance of our correspondent.—EDS. ELEC. REV.]

Institution of Electrical Engineers.—MANCHESTER SECTION.—The following alterations have been made in the dates of the papers to be read before this section:—

Tuesday, March 3rd.—E. W. Cowan, M.I.E.E., and L. Andrews, M.I.E.E., "The Arrangement and Control of Long-Distance Transmission Lines."

Tuesday, March 17th.—C. D. Taite, M.I.E.E., and R. S. Downe, A.M.I.E.E., "Comparison Between Steam and Electricity-Driven Auxiliary Plants in Central Stations."

Tuesday, April 21st.—A. H. Gibbings, M.I.E.E., "The Carriage of Goods on Electric Tramways" (with lantern illustrations).

The annual dinner will be held on Friday, March 6th.

STUDENTS' SECTION.—The visit to the London United Tramways Co., fixed for March 7th, has been postponed for the present.

Personal.—At the Midland Railway meeting the other day the chairman said that though Mr. W. Langdon had retired from the headship of the electrical department, he had been retained as consulting electrical engineer, and the work had been divided between the locomotive department and the way and works department.

Mr. Joseph Chamberlain, late assistant manager of the Tunbridge Wells municipal telephone department, has been presented by the staff with a solid silver cigarette case and match box.

Mr. E. W. Winter has been elected as president of the Brooklyn Rapid Transit Co., to succeed Mr. J. L. Greatsinger.

Last Saturday Mr. J. W. Ewart, on relinquishing his position as assistant manager of the arc lamp department of Messrs. Crompton, at Chelmsford, to take up a post in the Midlands, was presented by the foreman and workmen with a gold lever watch, suitably inscribed.

Mr. G. L. Andrews, resident engineer to the Sunderland tramways, has resigned that position, as he has obtained a more lucrative position in Lisbon.

Mr. John Tweedie has left the staff of the British Westinghouse Co., and taken an appointment with the London Exhibitions, Ltd., as chief electrical engineer.

Static Electricity for Ore Dressing.—Mr. W. G. Swart has recently described in the *Engineering and Mining Journal* a static electric ore separator, invented by Prof. L. I. Blake and Mr. L. N. Morscher, of Kansas. It has been found that most of the sulphides, and many of the other compounds of the valuable metals, possess high conductivity, whereas the gangue of an ore, quartz, lime, &c., consists largely of non-conducting material. If, therefore, crude crushed ore is brought into contact with a statically charged metallic surface, the good conductors are instantly repelled, while the bad conductors are not repelled until sufficient time has elapsed to allow them to be pulled out of their original path, and diverted into a separate compartment in the machine. Compounds of zinc, however, are exceptions to the above rule; so that, for example, an ore may be separated into a mixture of iron pyrites, copper pyrites, and galena in one receptacle, and into zinc blende in the other; or magnetic oxide and magnetic pyrites (of iron) may be separated from zinc sulphide, as long as the mineral is dry, and without the necessity for any preliminary roasting. The standard type of separator employed is a double one, 24 ft. long, 81 in. high, and 41 in. wide, constructed almost entirely of wood, and having but few wearing parts. It takes any material crushed to a mesh between 8 and 200, its nominal capacity being from 12 to 15 tons per 24 hours when working on blende concentrates of 30 mesh. Naturally the capacity of the machine is largely dependent upon the mesh of the ore, coarse material passing through quickly, and "fines" going more slowly. It is not necessary, or even desirable, that the ore shall be closely sized, because the machine is built in duplicate to take the fine on one side and the coarse on the other. The separator consumes about 1 H.P., which includes the energy required to generate the static charge. The electrical apparatus has been devised by the same inventors; it is built principally of metal, and includes no glass; it is self-exciting, and able to run continuously in the open air irrespective of weather, producing a voltage of 10,000 to 20,000. A test was made in the machine on Joplin jig concentrates, which contained about 44 per cent. coarser than 20 mesh and 56 per cent. finer. It gave on analysis 49·2 per cent. of zinc, 9·62 per cent. of iron, and 2·28 per cent. of lead. Without sizing or roasting, the ore was run through at the rate of 16·11 tons per 24 hours, and gave an iron concentrate containing 39·24 per cent. of iron, 8·89 per cent. of lead, and 3·60 per cent. of zinc; and a clean zinc blende containing 60·69 per cent. of zinc, 2·03 per cent. of iron, and a trace of lead. The loss was 1·57 per cent., but this included the samples taken for examination. When the material was graded to 20 mesh, and the fine and coarse put through separately and afterwards mixed, the clean zinc product carried 61·81 per cent. of zinc. A sample of Colorado "black jack" run through without sizing at the rate of 12·83 tons per 24 hours, gave an iron concentrate containing 35·14 per cent. of iron, 9·05 per cent. of lead, and 8·14 per cent. of zinc, and a zinc blende containing 51·18 per cent. of zinc, 8·80 per cent. of iron, and 0·60 per cent. of lead; the original material testing zinc, 30·37 per cent.; iron, 20·14 per cent.; lead, 4·60 per cent. The machine is not confined in its action to ores of zinc. It is capable of separating most sulphides and arsenides, and some carbonates and oxides from the gangue of silica or lime, in many instances the extraction being very high. This is particularly true of copper sulphide. A machine has been in operation at the works of the Colorado Zinc Co. for some little time, and others are to be laid down there shortly.

Lecture.—A lecture was delivered by Mr. H. A. Jones, the manager of the Phœnix Dynamo Co., Ltd., on Thursday last week, to the members of the Yorks. Automobile Club, at Bradford, on the subject of "Electricity as Applied to Motor-Cars." Electrical ignition was dealt with in some detail.

International Fire Prevention Congress.—It has been decided to open this Congress on July 7th with a general meeting, followed by sectional meetings on July 8th and 9th. The Congress offices will be at 1, Waterloo Place, London, S.W., where particulars can be obtained from the hon. secretary. Those desiring to participate in the discussions or to present papers should make their applications before the end of March.

Exhibition at Rhyl.—An electrical exhibition is to be held at the Rhyl Town Hall on March 11th, 12th and 13th. See our advertisement pages this week.

The Commercial Purification of Water by Means of Ozone.—In connection with the description of the Wiesbaden-Schierstein Ozone Water Purification Works recently given in this journal (January 2nd, 1903), a paper by Prof. Proskauer and Dr. Schüder in the *Zeitschrift für Hygiene und Infections Krankheiten* (Vol. 42, 1903) is of interest, and also affords striking proof of the efficacy of the new process. The method of test pursued was to artificially render water impure by adding large numbers of bacteria, and then to examine the same water after its passage through the sterilisation towers. The ozonised water was, however, not examined at once, as it was possible that the remaining bacteria would be in such small numbers, or so weakened in their capability of growth by the ozonisation, as to be difficult of detection. The samples were, therefore, so treated that they became particularly favourable to the development and increase of the bacteria, by the addition of peptone and salt, and were left for 24 hours at a temperature of 37° C. Any bacteria, therefore, left by the ozone would enormously multiply and would be very easy to find. The experiments were all made under the ordinary running conditions of the plant at the Wiesbaden-Schierstein works, and gave the result, identical with that obtained at the Martinikenfelder experimental plant of Siemens & Halske, that even with a water so impure as to be but seldom met with ordinarily, all germs which would render the water unfit for human use are killed. The conclusion is, therefore, justified that the ozone process, properly carried out on the commercial scale, can be relied upon to provide thoroughly sterilised water. Besides that at Wiesbaden-Schierstein, we understand Messrs. Siemens & Halske have supplied a similar plant to the town of Paderborn.

Institution of Mechanical Engineers.—The annual meeting was held on Friday evening; Mr. W. H. Maw, the president of the Institution, first occupied the chair. The secretary, Mr. Edgar Worthington, read the annual report of the Council. After referring to honours conferred upon members, also the losses sustained by death, the report said that a further report of the Gas Engine Research Committee will be delayed until a large experimental gas engine has been erected. Prof. T. Hudson Beare is occupied in perfecting the apparatus for testing the value of the steam jacket. Prof. David S. Capper has completed his experiments upon jacketed and unjacketed steam-engine cylinders, and a report is almost completed. The question of standard flanges has received the attention of the Council, and has been discussed by members during the past session. Mr. Maw resigns the presidency of the Institution this year, and is succeeded by Mr. J. Hartley Wicksteed, of Leeds.

Appointments Vacant.—A mechanical and electrical engineer for tramways at Reading at £300; an engineer-in-charge for Paisley. See "Official Notices" to-day.

Electrical Standardising, Testing and Training Institution.—Prof. C. A. Carus-Wilson will commence a special course of lectures to the senior students of the above Institution upon "Motor, Dynamo and Transformer Construction," on Monday next, March 2nd.

The National Electrical Manufacturers' Association.—The first annual general meeting of this Association was held at the Hotel Cecil, London, on January 28th, when matters of very general interest to the Electrical Manufacturers were brought forward, and it was generally shown that a satisfactory year's work had been done. The membership continued to increase, and it was generally felt that a good work had been done.

To Electrical Contractors.—The annual meeting of the National Electrical Contractors' Association will be held at Anderton's Hotel, Fleet Street, on Monday, March 2nd, at 7 p.m. A petition which is to be lodged in Parliament will be there, for the signature of electrical contractors.

Kircaldy Tramways.—The electric tramways system is to be publicly inaugurated to-morrow, Saturday.

Bath Electric Lighting.—At an adjourned meeting of the Bath City Council, held at the Guildhall on the 19th inst., the recommendation of the Electrical Committee to borrow £50,000 for the purpose of reconstructing its electrical undertaking was rejected by 16 votes to 14; an amendment limiting the expenditure to £22,000 was also defeated.

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell are instructed to sell by tender the works, plant and machinery of the Electro-Chemical Co., of St. Helens, Lancs. See advertisement pages to-day.

Automobile Exhibition.—The Society of Motor Manufacturers and Traders will hold its official exhibition of 1904 from February 18th to 24th.

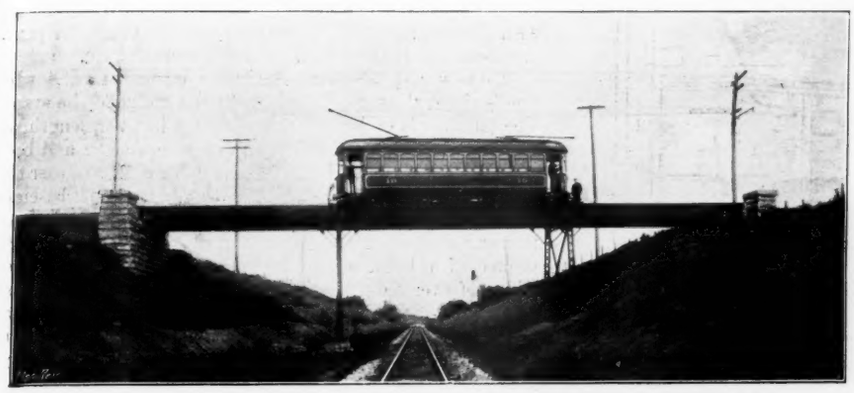
Yorkshire College Engineering Society.—Mr. A. V. Coster read a paper before this Society on Monday evening last on the "Modern Development of the Gas Engine."

New Zealand Water-Power.—The *British Australasian* says that the Cabinet has decided to obtain two electrical experts, one from Switzerland, and the other from America, to report on the adaptability of the New Zealand rivers for water-power and electrical purposes.

(*Continued on page* 361.)

THE WESTERN OHIO RAILWAY, U.S.A.

The Western Ohio Railway may be taken as typical of the kind of line common in America, and already attracting attention in this country, which, strictly speaking, is neither a tramway nor a railway, but something between the two, combining, to a great extent, the speed and length of the railway, with the comparatively light construction of the tramway. The advantages of such lines in districts which are not sufficiently populous to support an ordinary railway service are obvious. Single-car trains are run, and so a very frequent service is obtained; the working expenses are not excessive, and high speeds are attained on a permanent way which costs much less than that of a main railway line.

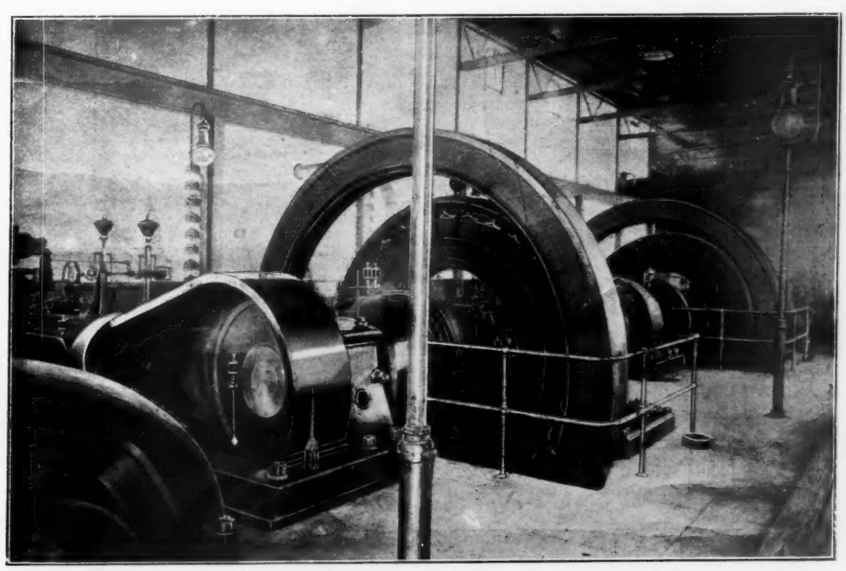


Car on Bridge over Railroad.

There are now about 45 miles of this line in daily use, and 64½ miles in addition are under construction, so that it will be seen that the system is of no small extent. The rails used on the portion of the line already constructed are of the "T" type universal in America, weighing 60 lbs. per yard, and 30 ft. in length, laid on sleepers 5 in. × 7 in. × 7 ft., and bonded. The road bed is ballasted throughout with rock crushed to a 1½-in. ring gauge, and screened, and is from 8 to 12 in. thick under the sleepers; it is carried out 6 in. on each side of the sleepers, shouldered and sloped to ensure perfect drainage. The new part of the line will be of rather heavier construction, 70-lb. rails being used in 30 ft. lengths, and 6 in. × 8 in. × 8 ft. sleepers will be used, spaced at 2 ft. centres. The bonds are fitted with the aid of a hydraulic compressor. The maximum gradients on the line now built do not exceed 1 in 50, except where main railway lines are crossed. On the new part of the line the gradients are being kept very low, and the permanent way is above ground level almost throughout.

The cars now in operation were built by the G. C. Kuhlman Co., of Cleveland, mounted on Peckham trucks, and electrically equipped by the Westinghouse Electric and Manufacturing Co., of Pittsburg. They are 42 ft. 6 in. in length over all and 8 ft. 8½ in. wide; the wheels are 33 in. in diameter, and each axle is 5 in. in diameter. Four Westinghouse No. 56 railway motors are fitted, with nose suspension. The cars are double-ended, and are geared up to a maximum speed of 48 miles per hour, with a gear ratio of 30 to 52. "Straight" air brakes are used, and each car is supplied with an independent motor-driven compressor enclosed in a dust-proof box underneath the car. There are now on order, in addition to the above, 24 new passenger coaches, to be built by the Niles Car and Manufacturing Co. These will be 44 ft. 10 in. long and 8 ft. 9 in. wide over all, and will be fitted with the same type of trucks and electrical equipments as the original cars.

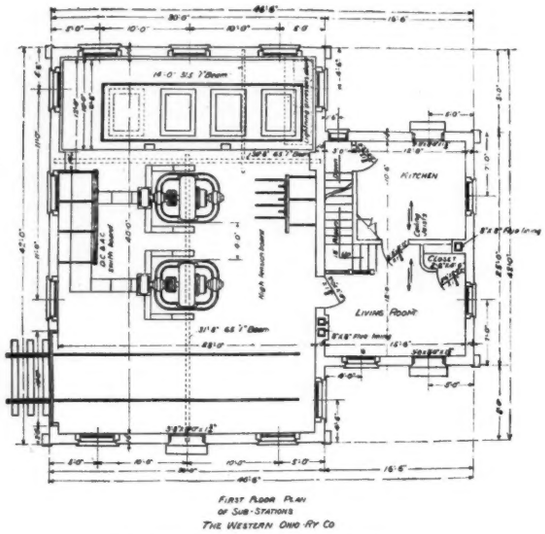
The high-pressure transmission line from Wapakoneta to St. Mary's is carried on 45-ft. poles, the brackets being arranged for three sets of 33,000-volt three-phase lines. At Wapakoneta one set turns off southwards and supplies sub-stations at Anna, Sydney, and Lockington; the other two sets continue north as far as Lima, one supplying Wapakoneta and Lima, the other Beaver Dam and Rawson. The cables are carried on Locke porcelain insulators, on steel pins with wooden tops; the cross arms are of long leaf



Westinghouse Three-Phase Alternators and Cooper Engines in Power Station.

yellow pinewood. All the high pressure lines are completely spiralled every mile, each set being spiralled in the opposite direction to the adjacent one, so that the feeders on the two pins next the pole at each side are of the same phase.

The sub-stations along the line will be seven in number, at the places indicated in the preceding paragraph; the



GROUND PLAN OF SUB-STATION.

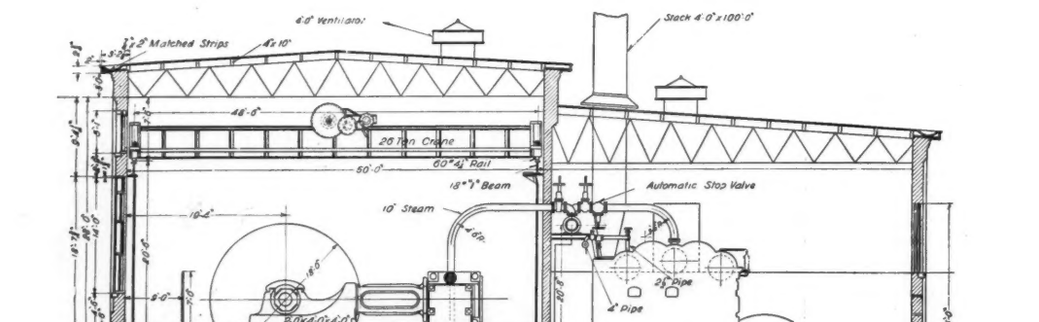
arrangement of the sub-stations is shown in the accompanying plan. They are of brick, with 13 in. walls above the foundation line; the floors and transformer pits will be of concrete, and the copings are covered with cement. Two rotary converters of the Westinghouse type are installed in each, and with the exception of those in the central station itself, these are all of 200 KW. capacity. These machines run at 500 revolutions per minute and deliver 333 amperes at 600 volts, the ratio of conversion from A.C. to D.C. being 0·62. As is usual in Westinghouse converters, a small induction motor is permanently mounted on the same shaft as the armature, for starting purposes, the armature being run up to synchronous speed by means of this motor before the main current is cut in. The Westinghouse oil-cooled transformers in the sub-stations step-down the current from 33,000 to 390 volts, for supply direct to the rotary converters. The switchboards are of the standard Westinghouse type, with long scale, dead-beat instruments, and present no unusual features.

In addition to the seven above referred to, there is an eighth sub-station of particular interest. This sub-station is portable, being mounted on a car, so that in case of a breakdown of any of the ordinary stationary sub-stations, this car can rapidly be brought along to take its place, and relieve the strain on the two stations adjacent to the one put out of operation. The car is 27 ft. long, 8 ft. 10 in. wide, and 10 ft. 6 in. high from the top of the rail; its equipment includes one 200-KW. rotary converter, three 150-KW. step-down transformers, three fuse-switch circuit breakers with barriers, and one three-panel switchboard, with alternating and direct-current rotary converter panels, direct-current feeder panel, lightning arresters, &c.

The power station which supplies current to the whole line is situated at St. Mary's, near the centre of the system. The building is of brick and concrete, 248 ft. in length, and 102 ft. in width, divided lengthwise into engine and boiler rooms. The floor level of the boiler room is 12 ft. lower than the floor of the engine room, and there is a 12-ft. basement beneath the latter; this basement is to be used as a transformer room. The engine room floor consists of steel "I" beams with brick arches between, filled in with concrete. The roof over the entire building consists of flat steel trusses, carrying 3-in. tiles, with a four-ply asphalt and gravel covering. The engine room is bridged by a 25-ton travelling crane, to ensure the rapid and easy handling of heavy engine parts.

The ultimate capacity of the power station, according to present plans, will be 4,000 KW., but at present the plant consists of only two 400-KW. sets. Foundations, have, however, been completed for two more sets, of 750 KW. each, and these will be in operation very shortly. These engines will be of the horizontal cross-compound condensing type, with Corliss valve gear, and cylinders 24 in. and 48 in. × 48in. stroke. The engines were designed for parallel operation with three-phase alternating current generators, with a guaranteed regulation of 1 per cent. In addition to these, two Westinghouse single-acting compound engines, with cylinders 13 in. and 22 in. × 13 in. stroke are employed, direct connected to the two 100-KW. exciters which are installed.

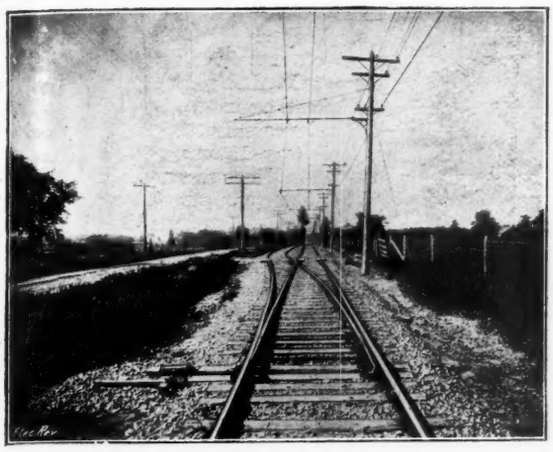
There are eight Stirling boilers in place, each of 375 H.P., giving a total capacity of 3,000 H.P. These boilers have flat grates, and each is provided with an independent guyed steel stack, 4 ft. in diameter and 80 ft. high. They are hand-fired, coal being supplied directly in front of the fire doors by a Hunt industrial railway system, consisting of a narrow gauge track, with turn-outs or crossing loops; the cars have a capacity of 1 ton each. The coal is shovelled directly from these small cars into the furnaces. The grate bars are of the herring-bone type, with ½ in. opening; the fuel used is West Virginia semi-bituminous



TRANSVERSE SECTION OF GENERATING STATION.

"run-of-mine" coal, which has been found very economical with this plant.

The pump and condenser room, which contains all the feed-water heaters, circulating pumps, vacuum pumps, and condensers, is located in the centre of the main boiler room.



View of Track, Showing Overhead Lines and Pneumatic Crossing Switch.

The water supply is taken from the feeder of the St. Mary's reservoir, distant about two-thirds of a mile, through a 24-in. pipe. The 30-in. Worthington elevated injector condenser includes an 8 × 16 × 12 in. rotary dry vacuum pump and two Worthington circulating pumps, either of which is of sufficient capacity to operate the entire plant. The main steam header consists of 16-in. heavy lap-welded steel pipe made up in sections, with pressed-steel flanges shrunk on and then turned and faced. All valves over 8-in. diameter are supplied with bye-passes; all over 3 in. are flanged, the flanges being tongued and grooved. The feed piping is suspended from the roof trusses by long I-bars, having turnbuckles in them to allow for adjustment and variations of height. All feed valves are arranged to be controlled from the boiler floor line, as are also all gauge cocks, blow-off pipes, &c., around the boilers.

The entire electrical plant was supplied by the Westinghouse Electric and Manufacturing Co. The alternators are of the three-phase revolving-field type, with 30 poles, running at 100 revolutions per minute, and each guaranteed to deliver 577 amperes per terminal at 400 volts with non-inductive load. When working at the full rated load of 400 KW., these generators require an exciting current of 90 amperes at 100 volts. The new 750-KW. generators are of the revolving field type, with 32 poles, running at 94 revolutions per minute. On full non-inductive load, these machines will deliver 1,083 amperes per terminal at 400 volts three-phase, and will require an exciting current of 150 amperes at 100 volts. These generators run remarkably cool, owing to the provision of ample ventilating ducts in spider, core, and winding, permitting an excellent circulation of air.

In addition to the above machines, the power station contains two 400-KW. rotary converters, which supply approximately 25 miles of the feeder system of the line.

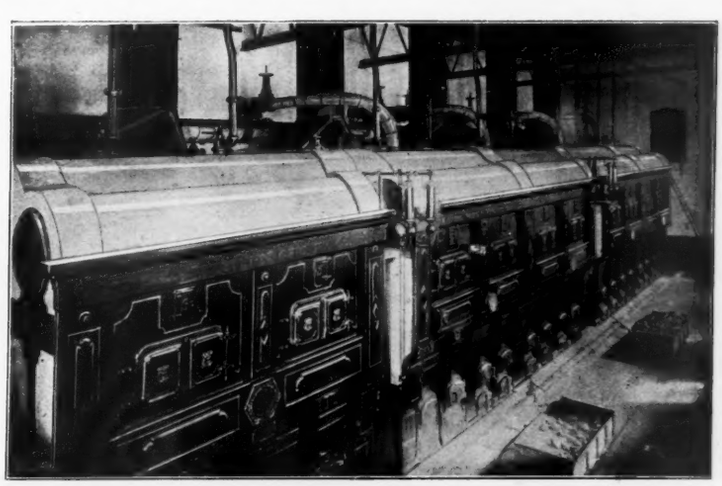
The engine room will contain two switchboards—a low pressure board of 11 panels, and a high pressure board of 9 panels. From the former are controlled the main generators, exciters, &c., and also the two rotary converters and feeders from them; the latter is devoted entirely to alternating current, carrying the transformer switches, meters, &c. The switchboards are all of blue Vermont marble, and are equipped with the necessary bus-bars, cable, &c. All feeder and transformer switching is done, as far as possible, on the high pressure side.

The step-up transformers, which are of the Westinghouse oil-cooled type, and step up the pressure from 390 to 33,000 volts, are installed in the basement underneath the engine room. There will be seven of 400 KW. capacity. From these, lead-covered single-conductor cables will be led up the wall of the building to the high pressure circuit breakers, of which there will be nine of Westinghouse pattern, and thence to the overhead transmission line.

Large car sheds are being built at St. Mary's, which will accommodate all the rolling stock of the line. There will be two buildings, placed end to end, separated by a pit traversed by a transfer table. The 15 lines of track in the sheds will have an aggregate length of nearly a quarter of a mile. Adjoining the car sheds are machine, mill and paint shops, stock room, and offices for the staff of the railway.

In conclusion, acknowledgments are due to Mr. D. W. Pell, the superintendent of construction, for the foregoing description.

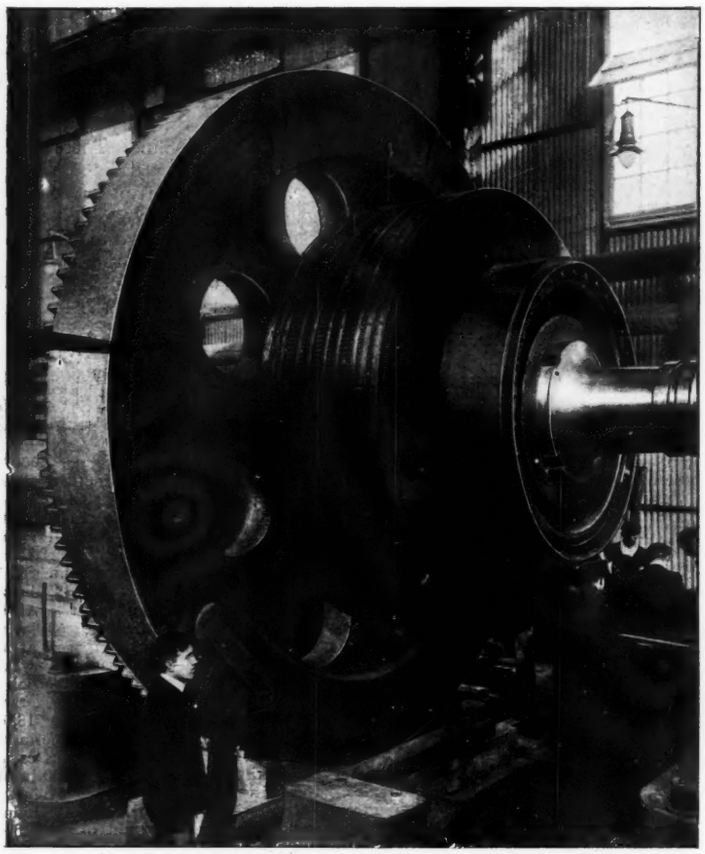
The Calcium Carbide Industry in France.—According to a report issued by the German Consul in Havre, the calcium carbide industry in France has undergone a considerable change in character since the Bullier patents were finally proclaimed good in the Paris Court of Appeal. The master patent controlling the manufacture of carbide is the property of the Société des Carbures Métalliques, a Parisian company founded by Bullier, which has a capital of 3,200,000 francs. This concern is now practically the owner of 17 carbide factories scattered throughout the Alpine districts, and retails its product through the agency of 50 dealers in different parts of the country, who are compelled to sell at the uniform price of 363 francs per metric ton—an arrangement which has been made in order to encourage the use of the material in districts furthest away from the factories, where it would otherwise be more expensive. The annual production is estimated at 18,000 tons. Forty villages are provided with central acetylene installations. In Havre carbide is sold retail at 48 to 51 francs per 100 kilos, in lots from 50 to 500 kilos; and at 45.50 to 48.50 in lots from 500 to 2 000 kilos. The existence of the Bullier patent has prevented the importation of any carbide, but the export trade is growing. Since calcium carbide is not itemised in the official export returns, it is not possible to give the exact figures; but it is probably more than 1,000 metric tons per annum at the present time. The material goes chiefly to Brazil, Argentina, Madagascar, the West Coast of Africa, and to China and Japan. Most of the large steamship companies still dislike taking carbide on board, and leave the carrying trade to the "tramps." Some carbide is sent abroad by sailing vessels. One firm in Havre, however, has made a special point of carbide exportation, sending away 300 tons in 1901 as against 100 in 1900. The price of carbide on board ship at Havre is on the average 350 francs per metric ton, a figure which includes 50 francs per ton, the cost of sending it from the works. The expense of shipping carbide to Brazil is 143 francs per metric ton; so that, including everything, French carbide costs about 550 francs per 1,000 kilos in Brazil, unless very large orders are being taken.



Stirling Boilers at Power Station.

LONDON COUNTY COUNCIL TRAMWAYS.

Considerable progress is being made with the construction of the plant for the London County Council tramways, and the two views given herewith are indicative of the position in which the plant stood a few days ago. The illustrations represent parts of one of the two 1,500-kw. direct current generators which are being supplied by Messrs. Dick, Kerr and Co., Ltd. The first shows the lower half of the yoke frame arriving at the Loughborough power house, and the second the armature pressed on to the shaft of the engine. These two machines are being erected at Loughborough Junction in works adjoining those of the South London Electric Supply Co. They are of the standard traction type of machine supplied by Dick, Kerr & Co., Ltd., and are to be coupled to Ferranti engines.



Armature and Fly-wheel of 1,500-kw. Dick-Kerr D.C. Generator.

The lower half of the field frame weighs a little over 15 tons, and the armature 23 tons. The armature, shaft and fly-wheel, however, approximate to nearly 80 tons. Good progress is being made with the remainder of the generating plant and sub-station equipment, which comprises two three-phase generators, each of 1,500 kw., and large sub-station plant consisting of one 750-kw. motor-generator and a number of 300-kw. machines.

Part of Magnet Frame of 1,500-kw. Generator.

RAILWAY BLOCK SIGNALLING.

Although signalling, electrical and mechanical, plays such an important part in railway working, the travelling public have but a small conception of its great importance, and little realise how much they have to be thankful for and what they owe to the inventors of the many improvements that have been made since railways have become absolutely necessary to every country for developing its resources and increasing its trade.

In a paper on "Railway Block Signalling," read by Mr. J. Pigg at the Institution of Electrical Engineers, Newcastle Local Section, at a meeting held on December 15th, 1902, some interesting descriptions of various signalling methods were described, and although the paper does not go much into detail, an excellent idea of the many branches of signalling is conveyed to the reader.

The term "block system" is, perhaps, rather misleading to the uninitiated, who imagine that if such a system is in operation, perfect safety is ensured, and that it is impossible for any accident or collision to occur; but as the block system alone is little else than an electrical instrument depending on man's intelligence and good memory, it cannot be expected to be perfectly reliable until brought into co-operation with the mechanical part of signalling, thereby producing union of the lock-and-block systems.

With regard to distant signals there seems to be a certain amount of inconsistency, as these in the day-time are indicated by a "notched" arm, but at night-time appear the same as any other signal; it is only by a very thorough knowledge of his railway that an engine-driver is able to pick out distant signals at night time, and it is to be hoped that before long some special "night" indication will come generally into use.

The interlocking of points and signals and the concentration of levers in signal boxes must be considered the mainspring of safety and facility in traffic control; the Southern counties of England may justly claim to be the home of railway safety appliances, seeing that as far back as the year 1843 Sir Chas. Hutton Gregory's signal interlocking frame of the stirrup pattern was installed at the Bricklayers' Arms junction on the Brighton Railway.

The maximum distance for working facing points from signal boxes has been increased from 150 yards to 180 yards, and in the year 1900 to 200 yards by the sanction of the Board of Trade, in consideration of the improvements in detecting gear between the points and signals.

Mechanical power for working points and signals is only in its infancy at present in England, although it is more used abroad; but it cannot be considered any quicker in operation of points and signals, and the installation, and particularly the maintenance of the same, are very much more costly than is the case with manual signals. As far back as 1870, power signalling was tried in England on the Metropolitan Underground Railway on the pneumatic principle.

In equipping signal boxes with "up-to-date" appliances the telephone must be remembered as a very important factor, and it is now so much in use on most railways that the manipulation of the single-needle electric instrument is fast becoming a "lost art" amongst signalmen. The introduction of the combined lock-and-block systems practically removes much responsibility, and makes signalmen more like machines than in by-gone days, when the block instruments and mechanical locking were not sympathetically combined. Now, until a train has passed out of the section, and has released the block instrument by means of treadles operated by the wheels, the signalman is powerless to accept another train in the same direction unless an undue use of the cancel or releasing key is made use of. This key may be considered the weak spot in lock-and-block installations.

Electric treadles have been very much improved of late, but it is difficult to make them sensitive enough to be perfect for every purpose, without being operated by the vibration caused by the passing of trains on other lines of rails.

Mr. Pigg seems to have quoted most of the printed Board of Trade requirements and recommendations for railways, but there are unwritten rules that have from time to time been brought into use by various railway accidents.

Fog signalling appliances have for some years been under the serious consideration of railway companies, but as a machine has not the power of speech, and as engine drivers sometimes lose their bearings, it is difficult to see how the human being can be superseded by the machine. Again, there is always the question of employment of platelayers during foggy weather when it is impossible, with any degree of safety, to work on repairs of the railway lines. Fog machines for laying detonators on more than one line certainly have advantages, because it is possible with such machines for one fogman to "fog" several lines without having to cross other lines, but at present it is unlikely that traffic superintendents will take the great responsibility of substituting the machine for the man. Many ingenious devices have been brought out for laying detonators on railways, and the companies are beginning to use some of them, such as Clayton's, Wood, Pinder, Brierly, and Detonator economisers.

As yet automatic signalling cannot be said to have found much favour in this country, although the London and South-Western Railway has a few miles in work between Grately and Andover on the British pneumatic system, and the North-Eastern Railway is making arrangements for equipping a section of its railway between Alne and Thirsk with a "track circuit" on the Hall (American) system. Hitherto it has been found difficult on account of the variable climatic conditions of this country to get good results in rail insulation without wastage of current, but with electric currents of low voltage it is now found more practicable. The ideal system, as Mr. Pigg puts forth, doubtless is one in which the train in a block section has control over the signals governing the entrance of that section.

It is a great question whether automatic signalling can ever be of much use where complicated junctions and stations exist in and around large towns or cities, on account of the marshalling and shunting of trains that is generally required at such places.

NOTES.

(*Continued from page* 356.)

Sparking Plugs for Automobiles.—A curious phenomenon has been observed and turned to good account, in the operation of the sparking plugs used for ignition purposes in petrol motors. It is well known that the sparking points inside the cylinder are very apt to become short-circuited, by carbon deposited from the oil used to lubricate the cylinder and guide; probably the majority of stoppages of petrol cars are due to this cause. Recently Messrs. Panhard & Levassor accidentally discovered that, by the interposition of a spark-gap external to the cylinder, in series with the secondary circuit, all trouble from this cause was entirely obviated, and the firm in question is introducing a device embodying this improvement, for general use. At first sight the *modus operandi* of the apparatus appears somewhat obscure, and it has aroused much speculative discussion. The true solution seems to be disclosed in a letter written to the *Autocar* of the 24th ult, by Mr. H. C. Haycraft, who points out that the presence of the "soot bridge" between the points renders it impossible for the potential difference necessary to produce a spark between the points to be obtained; the leakage path enables the discharge to take place quietly, and without disruption, very much as the points of a lightning conductor dissipate induced charges, without permitting them to accumulate until a violent discharge takes place. When a complete break is provided in the circuit, no current passes until the pressure has attained a value sufficient to leap the gap, and the soot bridge is either unable to cope with the heavy momentary current, so as to prevent a spark, or is rendered incandescent by the intensity of the discharge — just as a discontinuous lightning conductor is useless to prevent discharge, and becomes upon occasion the cause of disastrous disruptive discharges. As Mr. Haycraft remarks, "it is a matter for surprise that so simple and valuable a suggestion comes as the result of accidental observation, rather than deliberate experiment."

Musical Sounds from Vacuum Tubes and Flames.—Following up the experiments of Mr. Duddell on the singing arc, Prof. A. Righi, of Rome, has succeeded in obtaining musical sounds from vacuum tubes. A tube with aluminium electrodes, at a distance apart of 0 05 mm. for a rarefaction of 1 cm. of mercury, is connected through a high resistance with a battery of 800 volts, a current of a few milliamperes being allowed to flow. The tube is shunted by a condenser and a telephone in series. Musical sounds are given out, and the pitch can be raised by reducing the added resistance, the capacity of the condenser, the distance between the electrodes, or the pressure of the air in the tube; increasing the voltage has a similar effect. Instead of a vacuum tube the flame of a Bunsen burner may be used, and in some cases the best results are obtained when the flame is rendered a better conductor by volatilising common salt on the electrodes.—*Revue des Sciences.*

Electro-Harmonic Concert.—To-night is a ladies' night at the Electro-Harmonic. The proceedings will be held at the Holborn Restaurant, and will commence at 8 o'clock as usual. The programme is very varied and interesting, and should attract a large gathering. The vocal artistes are the Misses Edith Serpell and Ethel Bevans and Mr. Franklin Clive. Selections of instrumental music will be rendered by the orchestra; Mr. A. E. Izard will play pianoforte solos, and there will be a violin solo by Mr. T. E. Gatehouse. Mr. H. M. Higgs will be at the Mustel organ. Conjuring sketches will once more be given by Dr. Byrd Page, who has delighted Electro-Harmonic audiences on so many occasions. Mimetic and ventriloquial sketches by Mr. John Warren, and humorous sketches by Mr. Frederic Dale, complete the programme.

Two Views of the Motor-'Bus.—On February 17th the principal 'bus companies of London held their meetings in London, and at both the question of the motor-'bus received attention. The difference of opinion that exists will be seen by comparing the remarks made:—

The Deputy-Chairman of the London General Omnibus Co.

With regard to the question of motor-omnibuses, they had to consider that there were two or three different forms of mechanical traction. Perhaps the most comfortable and in some respects the easiest if it could be carried out was electric traction, but there were two insuperable objections to that form of traction—they would require large accumulators for the electricity which would be used in the course of the journey, and charging stations all over London. The next form of traction was steam, which he believed to be a very effective form of traction, but not for omnibuses. The great objection to it was the vibration, and he did not think the police authorities would allow 1,000 or 1,500 steam omnibuses to run in London. He believed that if anything was to be done in the future it would be by the adoption of petrol, but there was an almost insuperable objection to that at the present time—namely, the expense. He was not prepared to say in these inventive days that the time would not come when they might have a motor-omnibus that would pay, but up to the present there was no motor-omnibus in existence that would pay this company to take up. Only the other day one of the greatest authorities in electric traction, who was in consultation with the directors on the general subject, said he did not see that at present the company could run their omnibuses any cheaper with mechanical traction. They had no experience as yet as to how long a mechanical omnibus would last, whereas they knew that their present omnibuses lasted on an average fully 20 years. He was strongly of opinion that it would be a wonderful omnibus that would stand five or six years' wear with mechanical traction over the streets of London. The gentleman to whom he had already referred told the directors distinctly that if they were going to have motor-omnibuses, they must have three for two; that was to say, they would run two and have a spare one in case there was a breakdown. He thought the shareholders would agree with him that the time had not come for the company to take up motor-omnibuses.

The Chairman of the London Road Car Co.

In talking of the future, we cannot ignore the subject of mechanical power in place of horse traction, which has continuously engaged our most earnest attention during the past two or three years. At the present moment we have several types of motors under consideration, one or other of which we are sanguine will solve the problem. The only point not yet ascertained is as to the cost of running and wear and tear, which can only be proved by actual working. During the next few months, unless anything unforeseen occurs, you will see on the streets of London several road cars, the vehicles themselves somewhat of our ordinary type (with garden seats) driven by mechanical power of different kinds, and shareholders as well as the public will then have an opportunity of judging as to their suitability for public service. Whether there is to be any material saving in the cost of running our cars by mechanical power instead of by horses it is at present impossible to say, but there is no doubt that the mechanically-propelled road cars, being able to proceed at a faster speed than at present, will perform longer and more frequent journeys, consequently earning more money, and will doubtless be preferred by the public, owing to their being able to take up and put down passengers everywhere *en route*, to the underground tubes and electric trams necessarily running along rails confined to certain fixed routes and termini. Depend upon it the trump card will be held by the owner of the suitable mechanically-propelled vehicle, and no efforts shall be wanting on our part to make the London Road Car Co. that owner. With its large invested reserve funds and unexpended capital the position of this company in regard to this matter is undoubtedly a very strong one.

Physical Society.—At the annual meeting on February 13th, Dr. R. T. Glazebrook took the chair and delivered his presidential address. After thanking the members for electing him to the office of president, he referred to the work of Gladstone, Roberts-Austen, Griffith, and Wimshurst, four Fellows whom the Society had lost by death since the last general meeting. The Society had also lost two Honorary Fellows in Ricardo Felici and Alfred Cornu. Stokes was not a Fellow of the Physical Society. The Society regretted it, and were poorer for it. Turning to domestic affairs, Dr. Glazebrook mentioned the retirement of Mr. Elder, after ten years' work as secretary. The membership of the Society was almost stationary instead of increasing, and it was necessary to consider how best to further the interests of the Society. It should have a wider range of activity, and technical papers should not necessarily be excluded. If possible, all papers should be sent out, in full or in abstract, before any meeting, so as to encourage discussion. Interest might also be aroused by arranging at times for set discussions. The Society was at a disadvantage in having no home of its own, and the time of meeting might be reconsidered. Attempts should be made to give advice and guidance to physicists in isolated positions about the country having time to carry out research. The rest of the address dealt with the history of theoretical optics during the last 60 years and the part taken by Stokes in its development.

The Steam Turbine in America.—The steam turbine appears to be attracting much attention in America. One writer on the subject who discusses the question of superheat, contends for moderation of this, the advantages of which are liable to be overestimated. He says that, thermo-dynamically, steam in the turbine when superheated does no better than in the ordinary engine, and that while it corrects the faults of cylinder condensation, there is less of this to correct in the turbine. Probably he is about right. Superheat in the turbine is less required for the prevention of initial condensation, and therefore less superheat ought to suffice to produce a dry exhaust. A turbine is not perfectly adiabatic, however. There must be a travel of heat along both the case and the rotor towards the cooler and larger end. This loss tends to produce some initial condensation, and there are further heat losses due to radiation. We think it extremely doubtful, however, whether any good can come of superheating to very high degrees—dull red was suggested by one writer as possible. Though there may be no rubbing contact of cylinder and piston to take into account, the turbine has bearings, and these would have to be kept cool. The problem is not simple, and excessive degrees of superheat are by no means lightly to be undertaken. Various types of turbine are coming forward, and the production of steam turbines seems destined to form quite an important section of the engineering industry.

The Electrical Section of the London Chamber of Commerce.—At the recent annual meeting of the Electrical Trade Section of the London Chamber of Commerce, Mr. R. Percy Sellon retired from the chairmanship of the Section, and Mr. C. P. Sparkes was elected as his successor, Mr. W. L. Madgen and Mr. C. H. W. Biggs being chosen as deputy chairmen.

Before retiring from the chair, Mr. Percy Sellon drew attention to the important work on which it had been engaged during the two years of his tenure of the chair. In the field of electrical traction the Earth Returns Committee appointed by the Section had successfully combated the attempt of the gas and water companies to throw the onus of the question of alleged electrolysis of their pipes upon electricity supply undertakings. The Committee in co-operation with the Tramways and Light Railways Association, had interviewed the authorities of Parliament, and enlisted their sympathy on the side of the electrical industry, with the result that the threatened injustice referred to had been averted and the onus properly apportioned. Then, in the matter of the action of the Postmaster-General in unduly increasing the stringency of the clauses protective of the interests of the Post Office, the Committee had met the Postmaster-General and the technical officers of the Post Office, and subsequently Lord Morley. In the result a conference to consider the question of guard wires and cognate matters had been convened. In the field of power distribution the Section had done important work. By the appointment of the Power Bills Committee, representative of practically all the bulk power supply schemes sanctioned by Parliament, the Section had erected a standing body capable of conference upon questions of policy and procedure affecting present and future power Bills. This Committee had done valuable work in averting the creation of a menacing precedent in connection with the Lancashire Power Bill. The Power Mains Regulation Committee appointed by the Section had investigated the conditions under which bulk power schemes are being conducted in America, France, Germany and Switzerland, and had compiled and published a report which had thrown light upon this subject in connection with the Board of Trade regulations bearing on bulk power supply. At the present moment a representative of this Committee was a member of the informal Committee convened by the Board of Trade to consider this whole question. In the field of electricity supply the Section had, in co-operation with the Institution of Electrical Engineers, made representations upon the original suggested clauses of the Factory and Workshops Act, with beneficial result. The Section had also been in close co-operation during the past two years with the Municipal Trading Committee of the Chamber, which had originated as a Committee of the Section. He himself had during last year contributed a paper before the Chamber on "The Electrical Industry and Legislation: the Need of Revision." In conclusion, Mr. Sellon paid a tribute to the attention which the affairs and interests of the Section had received during his term of office, from the secretary, assistant secretary, and other permanent officers of the Chamber, and expressed his belief in the value, actual and potential, of the Electrical Section of the Chamber as an instrument for safeguarding the commercial interests of the electrical industry. In vacating the chair he suggested as his successor Mr. C. P. Sparkes.

Sub-Committees of the Section relating to Power Mains Regulations, Earth Returns and Power Bills were re-appointed. It was also agreed that the Section should support the recommendations of the Mansion House Committee on the Port of London; that agents in this country should be chargeable with a tax upon the profits made by their foreign principals in this country; that the series of questions issued by the Manufacturers' Section of the Chamber in regard to Workmen's Compensation Act Amendments be sent to the members of the Electrical Trade Section.

Electric Arcs between Metal Electrodes.—Prof. C. E. Guye, Geneva, and Mr. B. Monasch, read before the Congress of Swiss Naturalists, held at Geneva in September, 1902, an interesting paper on "Low Intensity Electric Arcs between Metal Electrodes." An account of this communication was given in the October issue of the *Archives des Sciences Physiques*. The experiments were made in air; the authors contemplate simplifying the conditions of the problem by working with simple gases and direct current. Using copper electrodes and a current maintained constant at from 0·041 to 0·053 amperes, the consumption of power is practically proportional to the distance apart of the electrodes, at least between 3 and 10 mm., a result analogous to those found by Mrs. Ayrton with direct current arcs of moderate intensity between carbon electrodes, and by Mr. Henbach for alternating arcs at a pressure of about 100 volts. On progressively diminishing the distance while the current is maintained constant, for all the metals investigated, excluding iron, a critical point is found to exist, from which the arc will undergo a noticeable change, hissing and changing colour, *i.e.*, taking a bright blue tint. If the distance of the electrodes be further diminished from this transition point, the pressure necessary to maintain the same current will increase up to a certain point, from which it begins to decrease, until it becomes zero on the electrodes coming into contact. The phenomenon seems to be the more noticeable as the metals are better conductors; it is especially marked with silver and copper, less with gold and platinum, scarcely visible with nickel, and not at all visible with iron, at least, so far as the currents used are concerned. This change in the arc at a critical distance is likely to be a complex phenomenon, most probably connected with the singing-arc phenomenon, where the gaseous medium plays a prominent part, and possibly with the transformation of the arc in an oscillating discharge, because of the diminution of resistance due to the presence of conducting metal vapours. These results are recorded by a series of curves.

Dissymmetry in A.C. Discharge.—In a Russian contemporary Mr. B. Mitkiewicz enunciates the view that the phenomena occurring in Wehnelt's interruptor and similar instruments, where an asymmetry of the alternate current is operative, are quite analogous to those exhibited in the more simple case of the electric arc. The researches of Famin and Maneuvrier, Blondel, Aron, Lang and other physicists have shown that the least asymmetry of the electrodes, between which the alternate-current arc passes, results in an asymmetry of the current. The author points especially to Blondel's investigations, from which it results that two different cases may occur, one, for arcs less than 1 mm. in length, being characterised by a slight asymmetry, and passing in a most discontinuous way to the second case, with very considerable asymmetry. In order to test Lang and Aron's hypothesis, according to which the asymmetries should be due to the well-known fact that with asymmetrical electrodes and in the case of a direct-current arc, the potential differences necessary to obtain an arc of a given length, are different according to the direction of the current, the author investigates more closely the problem of the back electromotive force, the existence of which, instead of a passive resistance, appears to be definitely proved by Duddell's researches. In order to measure directly the latter, Mitkiewicz determines by an oscillographic method, using a Braun's tube, the curve of the potential differences at the electrodes of the arc, at the moment of its production. This curve exhibits two discontinuities, one corresponding with the moment of production, and another referring to the moment of extinction of the arc. The following table records the measurements, effected by compensation, of the back electromotive force, for pairs of electrodes consisting of six different substances:—

	Carbon plain.	Carbon cored.	Copper.	Aluminium	Iron.	Mercury.
	Volts.	Volts.	Volts.	Volts.	Volts.	Volts.
+Carbon plain (9 mm.)	12	14	16	16	16	6
+Carbon cored (10 mm.)	7	6	—	—	—	—
+Copper (5 mm.) ...	9	—	8	—	15	—
+Aluminium (5 mm.)	8	—	—	16	—	—
+Iron (8 mm.) ...	10	—	17	—	16	—
+Mercury	11	—	—	—	—	—

These results, the accuracy of which is from 0·5 to 1 volt, refer to a current of about 7·5 amperes; all these figures are very much smaller than the values generally ascribed to the "constant term" of the formula, whereas the values of the back electromotive force, as found by Duddell by means of an indirect method, are of the same order of magnitude as these results obtained by a direct determination. As regards the alternate-current arc, the connection shown to exist between the direction of the current and the back electromotive force will account only for a comparatively small asymmetry of the current corresponding with the first case, though the conductivity of the arc, equally depending on the direction of the current, should play as well an important part in these phenomena. But as to the second case, *i.e.*, with arcs of a length superior to 1 mm., neither the electromotive force, comparatively small for both directions, nor the discontinuous variations of the conductivity of the arc, are sufficient to explain such great asymmetries. The author therefore suggests that these may be due to a kind of unilateral conductivity of the gaseous medium, making itself particularly felt in the second case. The subject of this investigation appears therefore to be closely connected with the problem of discharges in a gaseous medium.

THE CENTRAL STATION ENGINEER.

We regret that through an oversight in our last issue, Mr. Furness was mentioned instead of Mr. Quin, in connection with the Blackpool Supply Station Accounts. Mr. Furness is the present engineer, having succeeded Mr. Quin on the latter's retirement to take up consulting work in April last.

Mr. Bruton, the assistant manager at the Ashton-under-Lyne electricity works, in severing his connection with the Corporation, was the recipient of a silver non-magnetic watch, a silver-mounted pipe and a pouch from the staff. Much regret was expressed at his leaving, as he was very popular both at the works and in the town, having been there before the undertaking started, and has done good service for the department.

Mr. Ernest T. Williams, of the Salford Corporation electricity department, has been appointed to the post of senior electrical engineer at Gibraltar. There were 83 applicants.

For the post of assistant engineer at Lowestoft electricity works there were 102 applicants, and Mr. W. J. May, assistant engineer of Stockport, was selected.

Mr. W. L. Winning, late engineer-in-charge at Pinkston power station of the Glasgow Corporation Tramways, was presented on Tuesday last with a set of books, slide rule and fountain pen from the members of the staff and friends, on the occasion of his leaving to take up an appointment on the staff of the construction department of the British Westinghouse Co.

NEW COMPANIES REGISTERED.

India-rubber Manufacturing Co., Ltd. (76,420).—This company was registered on February 17th, with a capital of £20,000 in £1 shares, to adopt an agreement with G. Schumacher, R. Ortman, R. Siller, A. Friedrich and P. Fischer, and to carry on the business of manufacturers of and dealers in all kinds of rubber goods, vulcanised ebonite, raw rubber, waste rubber, rubber substitute, reclaimed rubber, raw and manufactured gutta-percha, fibre, celluloid, asbestos goods, packing materials, bottle stoppers, electric cables, wires, fittings and machinery, &c. The first subscribers (each with one share) are:—G. Schumacher, 14, Foyle Road, Blackheath, india-rubber manufacturer; R. Ortmann, 226, Devonshire Road, Honor Oak, S.E., india-rubber manufacturer: C. Hasenbalg, 14, Foyle Road, Blackheath, clerk; W. Christen, 19, Kitto Road, New Cross, S.E., clerk; E. F. Scheele, 139, Tulse Hill, S.W., chemical works manager; A. J. Wilson, Elder Cottage, Maybank Road, Woodford, Essex, clerk; and F. H. Miller, Ashmere House, Acre Lane, Brixton, S.W., clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are G. Schumacher, P. Fischer and P. Haselburg; qualification, £50; remuneration as fixed by the company. Registered office, 88, Croft Street, Deptford.

Brooker & Goss, Ltd. (76,425).—This company was registered on February 18th, with a capital of £5,000 in £1 shares, to acquire the business of electrical engineers, contractors, tool and instrument makers, &c., carried on by H. Brooker and W. H. Goss, at Freezywater, Waltham Cross, as "Brooker and Goss," to acquire the benefit of patents No. 1,488 of 1901 (relating to improvements in electric measuring instruments), and No. 20,028 of 1899 (relating to improvements in micrometer and similar gauges), and to carry on the business of electricians, mechanical and electrical engineers, instruments and tool makers, suppliers of electricity, &c. The first subscribers (each with one share) are:—H. Brooker, Freezywater, Waltham Cross, electrical engineer; W. H. Goss, Freezywater, Waltham Cross, electrical engineer; J. W. Record, 10, Albany Road, Leyton, electrical engineer; W. H. Hollands, Holly Road, Freezywater, Waltham Cross, machinist; H. Akerman, 35, Allans Road, Ponder's End, electrical engineer; C. J. Burchall, Enfield Highway, photographer; and H. Tupper, 10, Albany Road, Leyton, electrical engineer. Minimum cash subscription 20 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven; the first are H. Brooker (managing director), W. H. Goss, J. W. Record and F. W. Cruttenden; qualification, 50 shares; remuneration, £25 per annum and 5 per cent. of the net profits remaining after payment of 10 per cent. dividend, divisible.

Traction Insurance Association, Ltd. (76,436).—This company was registered on February 18th, with 100 members, each liable for £1 in the event of winding up, to insure members on the mutual principle against loss or damage in respect of accidents from the working of electric or other tramcars, light railways, omnibuses, or other vehicles, and to adopt an agreement with P. G. H. Carvill and A. W. Johanning. The first subscribers are:—J. F. Albright, 96, Elm Park Gardens, S.W., civil engineer; P. G. H. Carvill, 29, Morpeth Mansions, S.W., barrister; C. G. Hentsch, 123, Bishopsgate Street, E.C., member of Lloyd's; H. I. Jeaffreson, 123, Bishopsgate Street, E.C., member of Lloyd's; A. G. Sherwood, 46, Hamilton Gardens, St. John's Wood, N.W., publisher; W. Smee, Norfolk House, Victoria Embankment, solicitor; and A. W. Johanning, Suffolk House, Cannon Street, E.C., secretary. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration, £100 each per annum, to be increased to £150 each per annum when premiums exceed £10,000.

Mersey Electric Supply Syndicate, Ltd. (76,474).—This company was registered on February 21st, with a capital of £3,000 in £1 shares, to carry on in the United Kingdom or elsewhere the business of electricians, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in all apparatus and things used in connection with the generation, distribution and supply of electricity, &c., and to adopt an agreement with A. H. Gibbings. The first subscribers (each with one share) are:—M. B. Cotterell, Waverley, Victoria Park, Manchester, electrical engineer; A. H. Gibbings, Lynton, Wellington Road, Heaton Norris, Stockport, electrical engineer; W. Gibbings, Hazeldene, Grassendale, Liverpool, metallurgist; G. Fleit, 110, Cannon Street, E.C., contractor; H. Scholey, 8, Abbey Court, Abbey Road, N.W., electrical engineer; T. Foggett, 7, Chatsworth Avenue, Walton, Liverpool, clerk; and J. L. Williams, 5, Cook Street, Liverpool, solicitor. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, 50 shares; remuneration as fixed by the company. Registered office, 5, Cook Street, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Power and Traction, Ltd. (54,749).—Issue on January 21st of £300 debentures, part of a series created February 19th, 1902, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital and light railway orders. No trustees. Total amount previously issued of same series: £2,700.

Woking Electric Supply Co., Ltd. (46,175).—Issue on January 24th of £300 debentures, part of a series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £18,750.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on February 3rd of £500 debentures, part of a series created July 18th, 1901, to secure £20,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £17,500.

Vandam, Marsh & Co., Ltd. (74,746.)—(Electrical Supply Manufacturers, London, Manchester, and Birmingham.) Issue on February 2nd, of £9,200 debentures, part of a series created same date to secure £10,000, charged on the company's undertaking and property, present and future including uncalled capital. No trustees. No previous issue of same series.

Tynemouth and District Electric Traction Co., Ltd. (30,664.)—A trust deed dated February 6th, 1903, to secure £20,000 debentures created by resolution of August 10th, 1902 (power being taken to make further issues up to half the subscribed share capital for the time being), has been registered. Property charged, the company's assets, present and future. Trustees: The Electric and General Investment Co., Ltd., 1 and 2, Great Winchester Street, E.C.

Edison & Swan United Electric Light Co., Ltd. (18,984).—This company's annual return was filed on January 12th. The capital is £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each. 116,400 "A" and 23,564 "B" shares have been taken up. 10s. per share has been called up on 89,261 "A" and £44,630 10s. has been paid. £363,152 10s. (being £3 10s. per share on 89,261 and £3 per share on 10,000) is considered as paid on 99,261 "A" shares. 17,139 "A" and 23,564 "B" shares are considered as fully paid Mortgages and charges: £444,023.

Isle of Thanet Electric Tramways & Lighting Co., Ltd. 49,979).—The annual return of this company was filed on December 31st, 1902, when the entire capital of £300,000 in 50,000 preference and 30,000 ordinary shares of £5 each, had been taken up. £5 has been called up on the preference and £150,000 has been paid. The ordinary shares are considered as fully paid. Mortgages and charges: £200,000.

W. T. Glover & Co., Ltd. (Electrical Wire and Cable Makers, Manchester) (56,124).—Issue on January 23rd of £5,000 second mortgage debentures, part of a series created May 7th, 1902, to secure £100,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £100,000 first mortgage debenture stock. No trustees. Total amount previously issued of same series, £80,000.

Leeds Copper Works, Ltd. (formerly English Electro-Metallurgical Co., Ltd.) (62,225).—A debenture for £50,000, created and dated February 6th, 1903, has been registered. Property charged: the company's property, present and future, as a first and floating security. Holders: F. W. Ramsbottom, 43, Spring Gardens, Manchester, and F. S. Kitchin, 43, Claremont Road, Manchester.

Dick Kerr & Co., Ltd. (Engineers, London) (63,407).—A trust deed, dated January 29th, 1903, to secure £300,000 debenture stock created by resolution of January 21st, 1903, has been registered. Property charged: certain lands, heritages, buildings, steam engines, &c., at Kilmarnock and Preston, and 87,000 preference and 40,000 ordinary shares of the English Electric Manufacturing Co., Ltd. Trustees: The Realisation and Debenture Corporation of Scotland, Ltd., 41, St. Andrew's Square, Edinburgh.

Woolwich District Electric Light Co., Ltd. (31,814).—A memorandum of satisfaction in full of a debenture, dated January 2nd, 1903, to secure not more than £25,000 and interest, has been filed.

ELECTRIC TRAMWAY ACCOUNTS.

Sunderland and Huddersfield.

We give this week a comparison of the results obtained from the tramway accounts, &c., issued by the Corporations of Sunderland and Huddersfield. The former Corporation purchased the undertaking of the Sunderland (Horse) Tramways Co., and has since converted it to the overhead electric trolley system, under the supervision of the borough electrical and tramway engineer, Mr. J. F. C. Snell. The greater portion of the system is new, and the maximum gradient is 1 in 14. Mr. H. England is the tramways manager.

The passengers carried show an increase of 8,560,893, the total receipts an increase of £33,987, and the mileage an increase of 772,645, over those of the previous year.

The Huddersfield Corporation has just completed the transformation of its system from steam to the electrical overhead trolley, the operation extending over a period of about four years, during which time the traffic has been greatly interfered with.

The original 22 miles of steam route have been extended to 35 miles, covering certain portions of the neighbouring towns and districts of Mirfield, Honley, and Kirkburton, with running powers over the Linthwaite D.C.'s lines, the maximum gradient being 1 in 11. The electrical engineer and manager is Mr. H. N. Thomas.

—	Sunderland.	Huddersfield.	
Period covered by returns	12 months	9 months.	
Date ending ...	March 31st, 1902	December 31st, 1902.	
Date of opening ...	Horse, Jan. 1, 1900 Elec, Aug. 11, 1900	February, 1901.	
Length of route ...	8·89 miles	28·5 miles.	
Total length of track	17·18 miles	35 miles.	
Av. No. of cars in use	35	—	
Car-miles run ...	1,170,207	Elec., 922,394, Steam, 47,817	
Passengers carried per annum	13,596,808	(Estimated) 7,841,432	
Capital expenditure to date	£223,540	£384,794	
		Electric.	Steam.
Traffic receipts ...	£56,243	£40,392	£2,554
Total receipts ...	£57,307	£40 392	£2,555
Working expenses...	£30,719	£21,595	£2,411
Gross profit ...	£26,588	£18,797	£143
Income per car-mile	11·75d.	10·51d.	12·82d.
Working expenses per car-mile	6·3d.	5·61d.	12·10d.
Int., sinking fund and depreciation	3·86d.	5·36d.	3·57d.
Total expenses ...	10·16d.	10 97d.	15·67d.
Profit or loss ...	1·59d.	—·46d.	—2 85d.
Cost of energy per car-mile	2·10d.	·45d.	
Average fare charged per mile	·7d.	·8d.	
Rev. per ml. of route	£6,367	£1,534	
Expenditure per ml. of route	£3,413	£1,618	

The foregoing table bears further evidence to the great economy of electric traction in comparison with steam, even if a liberal allowance is made for the small mileage.

In the case of the Sunderland tramways, a total of 1,232,910 units, or 1·05 units per car-mile, were consumed during the year, and the maximum power demanded with 50 cars running was 559 KW.

ANALYSIS OF WORKING EXPENSES.

—	Sunderland.		Huddersfield (electrical).	
	Gross.	Per car-mile.	Gross.	Per car-mile.
Electrical energy	£10,274	2·10d.	£1,731	·45d.
Salaries	637	·13d.	1,017	·26d.
Wages	13,655	2·80d.	9,903	2·58d.
Oil, salt, &c.	976	·20d.	442	·11d.
Rent, rates, taxes & insurance	1,461	·29d.	1,433	·37d.
Printing, stationery, uniforms, compensation, &c.... ...	1,870	·37d.	1,733	·45d.
Repairs and maintenance—				
Rolling stock	795	·16d.	3,509	·91d.
Permanent way	745	·15d.	912	·24d.
Electrical equipment ...	226	·04d.	638	·17d.
Buildings	80	·01d.	276	·07d.
Total working expenses ..	£30,719	6·3d.	£21,594	5·61d.

From the above table it will be noticed that the working costs in the case of Huddersfield are slightly lower than for Sunderland, and that both bear favourable comparison with such undertakings as Liverpool and Glasgow.

For Huddersfield the item for repairs and maintenance of rolling stock, and in Sunderland that for electrical energy, figure much higher than usual.

The following table shows the financial results obtained by the two undertakings for the period stated. In the case of Sunderland a net profit of £7,742 remains after meeting all charges. Huddersfield, however, shows a deficit of £1,805 (or ·46d. per car-mile) on the electric, and £567 (or 2·86d. per car-mile) on the steam undertakings; it is expected that, with the completion of the electrical system, much better traffic results will be obtained.

	Sunderland.	Huddersfield (electric).
Interest and sinking fund ...	£13,398	£14,307
Depreciation	5,448	6,295
Balance—profit or loss	7,742	—1,805
Gross profit	£26,588	£18,797

ELECTRICITY SUPPLY ACCOUNTS.

Liverpool Corporation Electricity Accounts.

The electrical undertaking of the Corporation of Liverpool maintains its position as one of the most successful—if not the most successful—in the kingdom.

During 1902 the Corporation has acquired the electric light order for Allerton, Woolton, and Childwall, and the undertaking of the Garston and District Electric Supply Co., Ltd. In all, two main and eight auxiliary stations are in operation; the total plant installed equals 21,190 KW. The undertaking has been managed during the past 20 years by Mr. A. Bromley Holmes—since 1896, as city electrical engineer—and the results obtained are an excellent testimonial as to his ability. The progress made during the last five years will be gathered from the following figures:—

Year.	From private supply.	From public supply.	From traction.	Manufacturing account. Sales and repairs.	Wages and material.	Profit.
1898	£50,809	£2,631	£437	£21,818	£18,954	£2,864
1899	59,713	1,925	7,362	19,501	17,432	2,069
1900	72,056	1,764	30,597	23,219	20,674	2,545
1901	91,311	1,907	68,913	23,962	20,671	3,341
1902	101,093	2,134	79,452	17,072	13,978	3,094

General Statement.

For year ending December 31st.—	1901.	1902.	Increase.
Total capital expenditure ...	£1,187,622	£1,336,709	£149,087
Units sold—			
Private lighting	6,006,685	7,039,350	1,032,665
Public lighting	228,949	256,154	27,205
Traction	13,782,508	15,890,579	2,108,071
Total number of units sold ...	20,018,142	23,186,083	3,167,941
Equivalent number of 8-c.p. lamps connected.	359,518	441,848	82,330
Maximum load in kw.	9,431	10,539	1,108
Gross revenue	£170,785	£189,550	£18,765
" Expenditure	£85,104	£88,968	£3,864
" Profit	£85,681	£100,582	£14,901
Average price per unit sold ...	1·94d.	1·89d.	—·05d.

The past year has not proved so satisfactory in regard to increase in units supplied as the previous year, the figures being 3,167,941 as against 8,453,807 in 1901; the increase in gross revenue also is £18,765 as against £61,015 in 1901. This, however, is set off by a greatly reduced rate of increase in expenditure, namely, £3,864 as against £24,812 in 1901. The comparative decrease in output is, no doubt, explained by the tramways extension having been practically stationary. The public lamps include 174 street arcs, as against 156 in the previous year.

The prices charged were:—For lighting, 3¾d. per unit up to 3,000 units per quarter, and 3d. per unit after; for power, 2d. per unit up to 3,000 units per quarter, and 1½d. per unit afterwards; for street lighting, 2d. per unit, and for traction 1·2d. per unit.

Revenue Statement.

	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Sale of energy	£162,049	1·94d.	£162,671	1·89d.	—·05d.
Meter rents	2,439	·03d.	2,829	·03d.	·00d.
Sale of fittings, &c., profit on manufacturing account	3,341	·04d.	3,093	·03d.	— ·01d.
Sundry receipts, rents ..	2,956	·03d.	958	·01d.	—·02d.
Gross revenue ...	£170,785	2·04d.	£189,551	1·96	—·08d.

In the works costs, the item for coal shows a reduction of ·13d. per unit, and now stands at the low figure of ·37d., the total costs being less than 1d. per unit.

Cost of Production.

For year ending December 31st—	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Coal and unloading same ..	£41,600	·50d.	£36,253	·37d.	—·13d.
Oil, waste, waser, and engine room stores.	5,295	·06d.	5,673	·06d.	·00d.
Salaries and wages incurred in generation and distribution.	14,635	·17d.	15,757	·16d.	—·01d.
Repairs and maintenance of engines, boilers, dynamos, mains, &c.	5,865	·07d.	10,975	·11d.	·04d.
Works costs	£67,395	·80d.	£68,658	·70d.	—·10d.
Rent, rates and taxes.. ..	7,258	·09d.	8,430	·09d.	·00d.
Management expenses, salaries of managing engineer, secretary, clerical staff.	8,756	·10d.	9,347	·11d.	·01d.
General establishment charges, stationery and printing, &c.	1,439	·02d.	1,131	·01d.	— ·01d.
Sundry expenses, repairs to property, &c.	256	·00d.	1,402	·01d.	·01d.
Total costs ...	£85,104	1·01d.	£88,968	·92d.	—·09d.

The gross profit for the year amounted to £100,582, which, after providing for financial charges (including £10,000 to the reserve fund) and a small item for bad debts, left a sum of £23,416, that was allocated to the renewal fund and general rates.

Profit Statement.

For year ending December t—	1901.	1902.
Interest on loans	£37,195	£39,152
Sinking fund account	24,400	27,726
Reserve fund account	10,000	10,000
Renewal fund..	6,503	11,387
Contribution to general rate	7,583	12,029
Provision for bad debts	—	288
Gross profit	£85,681	£100,582

CITY NOTES.

National Telephone Co.

On Thursday of last week, at Hamilton House, Victoria Embankment, Sir Henry Fowler, M.P., presided at the meeting of this company.

The Chairman, in proposing the adoption of the report, said that the income accrued in respect to the business of the half-year amounted to £868,462, as compared with £801,495 for the corresponding period of 1901, being an increase of £66,967. The working expenses for the half-year amounted to £473,267 12s. 1d., as compared with £444,391 13s. 8d. for the corresponding period of 1901, being an increase of £28,875 18s. 5d. The net result for the half-year (after deducting the Post Office Royalties amounting to £78,641 13s. 4d.) was a profit balance of £316,553 6s. 5d., as compared with £283,680 8s. 9d., for the corresponding period of 1901, being an increase of £32,872 17s. 8d. Those figures all related to the half-year, but they could not get a real criterion of the business unless they took a complete year, and therefore he would give them the comparisons for the years 1901 and 1902. In 1901 the gross income amounted to £1,576,209, in 1902 it was £1,691,705, showing an increase on the year of £115,496. The shareholders would recollect that 1902 had not been emphatically the best year the company could have had, for it had been disturbed by an amount of competition, which did not exist in the preceding year. In Post Office royalties in the year 1901 they contributed to the revenue out of the gross income £146,578; last year they contributed £154,407. That was a very heavy amount of taxation, being 10 per cent. of their gross revenue. Turning to the working expenses in 1901, they were £951,000, in 1902 £998,000. Of course they could not have an increased income without increasing the expenditure, but he thought the shareholders would agree that the increase in the former item was not disproportionate to the increase in the receipts. In 1901 they paid £220,250 in dividends, and last year £275,250, which represented the increased dividend which was paid upon the new capital which was raised at the end of 1901. Another figure which was a very encouraging one was that relating to the reserve. In 1901 they carried to the reserve fund £165,000, this year they proposed to carry £175,000, and while their carry-forward in 1901 was £7,300, this year they proposed to carry forward £12,400. He thought he was justified in expressing, on behalf of the board, their satisfaction with the working of the company during the last 12 months. Out of the available balance shown in the report, they recommended a payment for the half-year of dividends at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 4½ per cent. per annum on the deferred stock, being equivalent to 5 per cent. per annum on the ordinary shares now divided into preferred stock and deferred stock, less income-tax in all cases. In this year's payments was included the dividend of 6 per cent. upon the amount of preferred stock, which they raised in getting money into the concern. The capital expenditure during the year had been £562,000, as against £536,000. Their stations had increased from 219,000 to 245,000, showing an increase of 25,000, and that increase had been fairly spread over the whole of the kingdom. Their stock of materials, which in 1901 was £340,000, had now got down to £291,000. They were very anxious not to keep a larger amount of materials in stock than was absolutely necessary for the carrying on of the business, and therefore they had reduced it by about £50,000.

Mr. G. Franklin seconded the motion.

Mr. H. D. Hall, after congratulating the directors upon the satisfactory character of the report, asked a number of questions with respect to the relations that existed between the company and the Post Office. He said he would like to know whether the company were increasing their telephone areas, for if they were, he fancied they were increasing their troubles. He believed that ultimately the public would demand a smaller number of areas, and a more uniform rate of charge for using the trunk system. He had heard it said that the telephone was merely a local convenience, but he believed that with a low trunk charge, it would be used very largely for persons communicating with each other all over the country. He wished to know whether the company was prepared to allow free inter-communication with any development that was made outside London by the Post Office.

The Chairman, in reply, said he thoroughly agreed with the object Mr. Hall had in view, and the directors were anxious and willing to come to a satisfactory arrangement with the Post Office. They had done so in London, and he might say the arrangement was working most satisfactorily for both the Post Office and the public. With reference to the areas they were settled years ago, when the Government bought the trunk wires, and if the Government wished to have those areas altered, it was a matter for them, and not for the company. They had no power in the matter, the areas being fixed under the Act of Parliament as part of the arrangement under which the trunk wires were purchased. They felt that the payment of those trunk wire fees pressed very heavily, but the money did not go into the pockets of the company, but to the Post Office. It would be be very much to their advantage if these terminal charges could be either modified or done away with altogether, for under the present arrangement the public paid the Government, through the company, £300,000 a year for the use of the trunk wires. In order to induce the Post Office to give them those trunk wire facilities they were in the habit of guaranteeing to them a certain amount of revenue, but, after full consideration, the board had determined to discontinue the guarantee. It had been a heavy burden upon the company, and the board had come to the conclusion that they were not called upon to make good any deficiency which might result. He believed the present Postmaster-General was anxious to study the convenience of the public, and it was for the convenience of the public that the London agreement was entered into, and they were perfectly ready to enter into an agreement with the Post Office to get rid of these local difficulties. There was one matter he omitted to refer to in his opening speech, and that was to give them the number of telephonic messages, as compared with

telegrams. In 1901 they transmitted 723,250,000 messages, and in 1902, 796,538,000, while the number of telegrams transmitted during the year ended March, 1902, was 90,432,041.

The report was adopted.

Northampton Electric Light and Power Co.

Mr. F. H. Thornton, J.P., presided at the annual meeting on 19th inst. He stated that their coal bill came to £482 less than last year, and yet they had sold £763 worth more current. They had written off £800 on depreciation account and £302 from preliminary expenses, and were going to pay a dividend of 4½ per cent. as against 3½ for the previous year. Dealing with the negotiations with the Corporation for the purchase by the latter of the company's undertaking, he said the Council approached them—they did not wish to sell—and asked them to name a price at which they were prepared to sell. The directors had gone carefully into the matter, and, with the assistance of one of the leading experts in the country, who knew as much as any man in England about the sale of electricity undertakings, they fixed the price at £140,000. So far as they knew, the Town Council never employed any expert to go into the figures on behalf of themselves or enter into negotiations with them or their expert in regard to that sum. They (the Council) based their figures or calculations on last year's balance-sheet, instead of valuing the undertaking as a going concern. The goodwill, too, ought to have been taken more into consideration. After the negotiations for purchase fell through, the Council came to them to inquire their price for supplying current for the tramways. The directors had no particular wish to make much out of it, and quoted the lowest price at which it was possible to supply current, viz., 1½d. The Corporation rejected that offer, and proposed having an installation of their own at St. James's End. Now the Corporation had abandoned their undertaking in St. James's End, and proposed to generate sufficient current for the trams from the refuse destructor and some extra machinery. He did not know whether it would be a success, but in other places where they had tried to generate current in that way it had been a failure. It was curious if Northampton could do what other towns could not in the matter. No one had visited the company's works on behalf of the Corporation, and he thought it was extraordinary that they should try to buy anything without going to look at it. He thought the prospects of the company were extremely bright. After pointing out that a scheme had been adopted for letting out motors on hire at low prices, the chairman said that the use of motive power was making great progress. He pointed out that a reduction had been made in the price of current for lighting, which made it as cheap as it was anywhere else. After referring to the proposed extension of the area, he moved the adoption of the report.

Mr. W. Tomes seconded.

The Chairman paid a tribute to the work of the secretary (Mr. E. M. Browne), the chief engineer (Mr. G. S. Jackson) and the rest of the staff.

Telegraph Construction and Maintenance Co.

The report for 1892 shows a net profit of £99,406, after charging the interest on the debentures. To this sum must be added £91,619, brought forward from last year, making a total of £191,025. From this amount is deducted the interim dividend of 5 per cent., amounting to £22,410, leaving £168,615 to be dealt with. Of this sum the directors propose to distribute a dividend of £1 4s. per share, together with a bonus of 12s. per share, absorbing £67,230, being at the rate of 15 per cent., and making, with the amount already paid, a total dividend and bonus for the year of £2 8s. per share, or 20 per cent, leaving £101,385 to be carried forward to the next account. The business of the company carried out during the past year has been of a satisfactory nature, and the works at Wharf Road and East Greenwich have been actively engaged in the manufacture of submarine telegraph cables and of insulated wire. The company's steamships have been occupied in the laying of cables as well as in repairing operations. The factories and steamships have been maintained in efficient working order. The s.s. *Colonia*, the latest addition to the company's fleet, has proved herself to be in every way satisfactory and admirably adapted for her work. The directors propose to add a further sum of £20,000 to the pension fund established in 1899 for the benefit of the company's staff.

City of Carlisle Electric Tramways Co.

The report for 1902 states that revenue account shows a surplus of £3,039, being an increase of £581 as compared with last year, and the balance of profit and loss account, after providing for debenture stock interest, debenture stock trustees' remuneration, and writing off the balance of the preliminary expenses, is £1,592, which the directors recommend should be dealt with as follows:—To carry to the fund to meet depreciation, raising that fund to £2,000, £929, and to carry forward £663. The car-miles run in the period have been 320,129, as against 323,044 last year, a decrease of 2,915 miles, and the number of passengers carried 2,216,583, an increase of 205,710. After careful consideration, and owing to the shortness of the routes, the directors have introduced ½d. stages on some of them, and should the result prove satisfactory financially, they propose to extend them to the whole system.

City of London Electric Lighting Co.

The directors' report for the year ended December 31st, 1902, to be presented at the meeting held at Salisbury House, E.C., on Wednesday, says that the expenditure on capital account during the year ended December 31st, 1902, amounted to £45,773 1s. 11d.

The total revenue for the year	£249,293 13 9		
including interest on deposits, investments, &c. was	1,373 16 10		£250,667 10 7
From which must be deducted the following items:—			
Expenses of generation and distribution ..	£62,470 11 9		
Rent, rates, taxes, general and special charges	38,415 13 6		
Repairs and maintenance of buildings, machinery, plant, mains and other works	17,283 3 10		
	£118,174 9 1		
Interest transferred to debenture stock premium redemption fund	1,164 1 11		
Staff superannuation fund..	178 10 7		
		119,517 1 7	
Leaving ..			£131,150 9 0
To which must be added the balance brought forward from 1901			14,068 0 10
Making a total available revenue of ..			£145,218 9 10
Of this sum the following amounts have been distributed or provided for:—			
(a) Interest on first and second debenture stock for year ended December 31st, 1902 ..	£31,441 2 11		
(b) Interim dividend on £400,000 6 per cent. preference shares, paid in August last on account of the distribution for the year ..	11,275 0 0		
(c) Transfer to reserve account	35,000 0 0		
,, for leasehold redemption	500 0 0		
		78,216 2 11	
Leaving a balance of			£66,997 6 11

The directors recommend that the following dividends for the year ended December 31st, 1902, be declared, subject to the deduction of income-tax:—

Preference Shares Nos. 1 *to* 40,000.—12s. per share, being a distribution for the year at the full rate of 6 per cent. Of this sum 6s. per share was paid on account in July last, leaving a balance of 6s. per share for present distribution.

Ordinary Shares Nos. 40,001 *to* 110,595.—10s. per share, being a distribution at the rate of 5 per cent. for the year.

This will absorb £44,378 3s. 6d., and leave a balance of £22,619 3s. 5d., which the directors propose to carry forward. Warrants for the dividends will be posted on March 4th.

Private Lighting: Average Prices Per Unit Obtained.

1896.	1897.	1898.	1899	1900	1901.	1902.
7·41d.	7·30d.	6·22d.	5·16d.	4·09d.	4·54d.	4·04d.

The following comparative statements show the position of the company as it was at the end of 1895 and at subsequent periods:—

Private Lighting: Number of Customers and Lamps Connected.

December 31st ..	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Number of customers being supplied ..	4,230	5,303	6,322	7,414	8,738	9,855	10,618	10,988
Number (equivalent) of 8-c.p. lamps connected.	195,317	247,785	296,012	355,825	429,628	511,118	549,171	574,119

On February 11th, 1903, there were 598,550 8-c.p. lamps (equivalent) applied for, out of which 586,219 were connected, and the customers numbered 11,043. The B. of T. units sold during the year 1902, excluding public lighting, were 12,988,615, as compared with 11,526,951 for 1901.

Statement of Income as shown in the Audited Statements of Accounts Issued by the Company.

Year ended Dec. 31st	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Gross revenue (after deducting allowances to consumers) ..	£ 106,999	£ 146,916	£ 175,792	£ 175,607	£ 187,253	£ 228,776	£ 250,080	£ 260,667
Net revenue available for repairs and renewals, depreciation, reserve account, interest on debenture stock, &c., dividends and special charges	59,100	85,701	107,550	97,842	87,328	84,015	139,032	149,781

The directors have credited the debenture stock premium redemption account with £1,164 1s. 11d. from revenue for interest, and the amount at the credit of the redemption account at December 31st last was £49,668 1s. 8d. In order to simplify the accounts they have considered it advisable to place all the reserves shown in the accounts for 1901 under one heading, and consequently have caused the necessary transfers to be made. They have also transferred the sums of £35,000 and £500 from net revenue account to reserve account, thus raising the reserves as at December 31st, 1902, to £182,235 3s. 1d., in addition to which there are debenture stock premium redemption fund, £49,668 1s. 8d., and amount carried forward to 1903, £22,619 3s. 5d., making £254,522 8s. 2d. The appeals of the Corporation and of the company to the House of Lords have been set down for hearing, but have not yet been reached. The directors have constituted the company a member of the British Electrical Superannuation Fund, formed jointly by several electric traction and electric supply companies for the benefit of their respective staffs. The necessary resolution authorising the directors to make an annual subscription to the fund in proportion to the salary of each member of the company's staff who joins the fund, will be submitted to the shareholders. Mr. H. S. Leon retired from the board in May last, owing to his time being otherwise fully occupied. The directors received Mr. Leon's resignation with great regret.

Scarborough Electric Supply Co.

Mr. J. E. Ellis, M.P., presided at this company's meeting last Saturday. He said that the capital expenditure of 1902 had been much smaller than that of 1901. The revenue had increased by £35 and had reduced expenses. They had delivered 438,860 units against 384,165 in 1901, and had produced a revenue of £10,273 against £8,847. There was a balance on the year's working of £5,664, as against £4,277 in 1901—an increase of £1,400 roughly. Looking to the future for a moment, the company would have to make provision for a greater capital outlay than during the past year. The directors had been so satisfied with the 500-kw. generator—the economy had been very great as regarded the consumption of coal—that they had ordered a second machine at a cost of £4,000. There would also be expenditure in the replacing of old mains, and generally making the necessary extensions for the convenience of the public. They had no difficulty in raising money. They had never in the past had to go outside their own shareholders for additional capital. Referring to the proposed electric trams, he wished explicitly to say that so far as he personally and several other directors were concerned, they did not hold any financial interest in the tramway company, and it had been left to them by their colleagues to settle terms with the tramway company. Certain correspondence had passed, but a final arrangement had not been arrived at. He believed that the prospectus of the tramway company was now settled, and would be out in the course of the next few weeks. There was every prospect of that undertaking going on very rapidly now. The supply of current to the company would not be a large matter; it would not involve any great increase in capital expenditure, but whatever it required they would have no difficulty in raising.

Mr. Geo. Alderson-Smith seconded the adoption of the report, and it was carried.

W. T. Henley's Telegraph Works Co., Ltd.

The directors' report for the year 1902, to be presented at the meeting to-day at Cannon Street Hotel, says:—

The accounts show that during the past year a net profit has been made of £61,362 9s. 8d. After payment of directors' and auditors' fees, debenture interest and income-tax, and making the usual allowance for depreciation of buildings, plant, machinery, &c., there remains £53,557 4s. 8d., making, with £26,785 9s. 3d., brought forward from last year, a total of £80,342 13s. 11d. The directors have transferred £1,000 to the debenture redemption sinking fund, and £10,500 to the reserve account, and they recommend the payment of the following dividends, viz.:—On the preference shares at the rate of 4½ per cent. per annum (less income-tax), including the interim dividend already paid, and on the ordinary shares at the rate of 20 per cent. per annum (less income-tax), including the interim dividend of 6 per cent. paid on September 1st last. These payments will amount to £54,875, leaving £25,967 18s. 11d. to be carried forward.

Hart Accumulator Co., Ltd.

The report of the directors, to be presented to the meeting to be held on Wednesday, March 4th, at Stratford, E., at 12 o'clock noon, reads:—

The profit for the year December 31st, 1902, is £6,447 10s. 4d. and the balance brought forward from last year £4,429 15s. 2d., amounting together to £10,877 5s. 6d. The directors recommend the payment of a dividend of 15 per cent. per annum on the ordinary share capital, which will absorb £6,000, leaving £4,877 5s. 6d. to be carried forward. The company's buildings, plant, tools, &c., have been augmented by £665 10s. 7d., which has been charged to capital, and due depreciation on same has been made. The maintenance of the works, plant, &c., has been well kept up at a cost of £483 2s. 7d., which has been paid for out of revenue. The vacancy on the directorate caused by the retirement of Wm. Griffiths, Esq., has been filled by the appointment of E. J. Clark, Esq.

Electric Lighting and Traction Co. of Australia.

The directors' report for the year ended August 31st, 1902, states that, after paying interest on debenture stock and loans from bankers, and writing off the repairs and renewals incurred during the year, the profit and loss account shows a loss of £402 10s. 9d. The absence of net divisible profit for the year is due to decline in revenue from the Melbourne undertaking, consequent on the completion of the generating station of the Melbourne City Corporation, which has enabled the latter to supply consumers within its area who had previously taken their supply from this company. The revenue from the residential districts and suburbs outside the city area, for which this company hold an Order in Council, did not, during the period under review, suffice to compensate for the lost revenue from the city area. The work of laying mains in the suburbs has, however, been actively proceeded with, and the number of connections and applications received for light and power, amounting to the equivalent of some 40,000 8-c.p. lamps, now exceed the connections lost in the city. The total connections to the company's mains in Australia on August 31st, 1902, were as follows:—Melbourne, 36,000 8-c.p. lamps; Adelaide, 17,730 8-c.p. lamps; Geelong, 8,650 8-c.p. lamps; Port Adelaide, 4,238 8-c.p. lamps = Total, 66,618 8-c.p. lamps. Since the above date, the equivalent of approximately 10,000 8-c.p. additional lamps have been connected and applied for. The company's undertakings at Adelaide and Geelong have this year turned the corner, and are now established on a profit-earning basis. This result compares favourably with that of undertakings similarly situated in Great Britain and elsewhere. During the year capital expenditure in Australia on buildings and plant has been incurred as follows:—On the Melbourne undertaking, £37,049 1s. 3d.; on the Adelaide undertaking, £15,017 15s. 5d.; on the Geelong undertaking, £3,195 15s. = Total, £55,262 11s. 8d. In order to provide the capital necessary for the further development of the company's undertakings, the directors propose to issue forthwith the remaining £75,000 of the £150,000 5 per cent. debenture stock. Of the proceeds of this issue, between £10,000 and £50,000 will be spent on additional plant, mains, &c., and the balance will be applied in reduction of the loan from the company's bankers. The company's engineer and manager, Mr. F. W. Clements, considers that the expenditure of this sum will enable the net earnings of the company in Australia to be increased to £25,000 per annum. The shareholders will be asked to sanction an increase of the company's borrowing powers to an amount sufficient to enable the directors to create £150,000 second debenture stock.

Melbourne.—It will be seen from the profit and loss account that the gross profit from Melbourne for the past year amounts to £7,416 10s. 4d. The anticipated administrative economies are being duly effected. The Alcock station has been closed down entirely, and the generating machinery concentrated at the main station at Richmond. Further important economies will result from the pending completion of the new system of mains and transformers being laid down in the suburban districts. The directors have full confidence in the future of the Melbourne undertaking.

Adelaide.—Since the new station was opened in November, 1901, the equivalent of about 20,000 8-c.p. lamps have been applied for and connected. Further applications for light and power continue to be received so numerously that the directors are sending out additional generating plant, in order to be able to cope with next winter's load. The financial result for the past year shows a gross profit of £500 7s. 2d., after making good the loss incurred during the first three months' working under the old conditions.

Geelong.—This station shows a gross profit of £385 15s. 4d. for the past year, being the first complete year of its operation. The demand for light and power continues to be satisfactory.

Port Adelaide.—The directors regret that they have been unable to arrange for the closing of this small station during the past year, and in consequence it has continued to work at a loss. They hope, however, to be in a position to shut it down and connect the district to Adelaide at an early date, when the consequent reduction of working expenses will, they believe, convert the present loss into profit.

General.—The Stock Exchange granted an official quotation on April 29th, 1902, to both the company's first issue of £75,000 5 per cent. debenture stock, and the second issue of preference shares, numbered 20,001 to 30,000.

Chelsea Electricity Supply Co.

The directors' report for the year ended December 31st, 1902, shows that the profit amounted to £27,092, which, with £265 15s. 4d. balance of interest and £461 19s. 6d. brought forward, makes a total of £27,819 14s. 10d. After deducting £6,750 interest on debenture stock, £900 interim dividend on the preference shares, and £3,332 14s. interim dividend on the ordinary shares at the rate of 3 per cent. per annum, there remains a balance of £16,837 0s. 10d., which the directors recommend shall be appropriated as follows:—

To credit of renewals and depreciation fund	£8,960 0 0
To final dividend on the preference shares at the rate of 6 per cent. per annum, making 6 per cent. for the year	900 0 0
To final dividend on the ordinary shares at the rate of 6 per cent. per annum, making 4½ per cent. for the year	6,665 8 0
Leaving a balance to be carried to the next account of ..	311 12 10
	£16,837 0 10

The amount placed to the credit of renewals and depreciation fund is based upon the estimated life of the different descriptions of plant and property, and, although proportionately less than the appropriations of several metropolitan companies, is considered by the directors to be adequate. The price of coal has been lower, and the cost of production of the unit shows a satisfactory decrease. Expenditure amounting to £1,969 11s. 8d. has been incurred during the year in connection with changing the system of supply from 100 volts pressure to 200 volts. This amount has been added to the balance of the suspense account of the previous year, and one-third of the whole has been written off. Negotiations have taken place during the year with the holders of founders' shares with the view of cancelling those shares on terms satisfactory to the holders of the ordinary and founders' shares alike; but the directors are not in a position to make proposals thereon to the shareholders at the ensuing general meeting. The number of lamps connected on December 31st, 1902, was 176,002, an addition of 14,971 during the year, and the improvement in the units sold per lamp continues. The total number of units sold in 1902 was 2,257,559, being 246,409 more than the previous year. In 1901 two directors were added to the board. Mr. Nugent Daniell retired in June last, and it is not proposed to add to the present number of directors.

Kensington and Knightsbridge Electric Lighting Co.

The directors' report for the year 1902 says that during the year the number of houses and shops connected with the system has increased from 2,605 on December 31st, 1901, to 2,889 on December 31st, 1902, while the number of lamps calculated on the usual basis of 8-c.p. has increased from 222,158 to 249,870. The renewal account now stands at £44,144 16s. 1d., being an increase of £5,878 2s. 1d. over the amount of the account at the end of the previous year. After providing for the amount placed to renewal account, writing £1,392 2s. off cost of purchase of Kensington Court Co., Ltd., in the capital account, and after paying the dividends on the 6 per cent. first preference shares to June 30th, 1902, on the 5 per cent. second preference shares to September 30th, 1902, and an interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1902 is £13,207 19s. 8d. Of the above sum £1,500 has been appropriated

to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay out of the balance of £11,082 19s 8d. a further dividend on the ordinary shares at the rate of 10 per cent. per annum for the past half-year, making with the interim dividend paid on August 1st, 10 per cent. for the year. This will leave a balance of £5,832 19s. 8d. to be carried forward. The increase of supply from Wood Lane has enabled a still further reduction in the steam power to be made at Kensington Court. Certain of the engines have been removed from there, and have been re-erected at Chapel Place, replacing smaller engines which have been sold. The directors feel that the company is justly entitled to complain of the conduct of the London County Council in bringing forward an electric supply Bill in 1903, which, speaking broadly, is to all intents and for all purposes, a repetition of the Bill which was in Parliament and was rejected last year. The opposition of this company, with others, was successful, but that opposition caused a considerable portion of the £340 for "Law Expenses."

London Electric Supply Corporation.

The directors' report shows that the profit on the working for the year ended December 31st, 1902, is £35,342 5s. 11d., to which has to be added interest on deposit and amount brought forward, £1,513 7s. 4d., making a total of £36,855 13s. 3d. Out of this the interest to December 31st, viz., £14,332 17s., has been paid, leaving a balance of £22,522 16s 3d. The board propose to deal with this amount as follows:—

By payment of a dividend of 6 per cent. (or 6s. per share) on the preference shares, for the year ending December 31st, 1902, of which an interim dividend of 3s. 6d. per share was paid on September 1st, 1902	£14,952 0 0
To reserve account	6,000 0 0
To carry forward	1,570 16 3
	£22,522 16 3

The anticipations expressed in last year's report as to efficiency of supply and decrease in cost of production, have been more than fulfilled. The result of this satisfactory service has been a steady accession of new orders. The plant and machinery have been maintained out of revenue, and are in an efficient condition. The board have entered into an agreement with the London County Council for supplying power to the Council's tramways. This agreement will have the effect of still further reducing the costs and increasing the revenue of the corporation. Other negotiations are in progress for large power contracts.

Oxford Electric Co.

The directors' report for 1902 states that the revenue account shows a profit (including £109 16s. 6d. brought forward from last year) of £8,777 11s. 4d.

After providing £2,044 6s. 3d. for debenture and other interest and writing off £554 6s. 8d. on account of hire-purchase installations, the available balance net profit is £6,179 4s. 5d., which the directors propose to appropriate as follows:—In payment of a dividend at the rate of 5½ per cent. per annum on the share capital (whereof 2½ per cent. was paid in September last), £3,663 1s. 4d., and in adding £2,200 to the reserve and renewal of plant account, which will then amount to £4,500; the balance, £276 3s. 1d., to be carried forward to next year's account. It is estimated that there is now the equivalent of 46,010 8-c.p. lamps connected to the mains, and the prospects of additions during 1903 are satisfactory. The number of Board of Trade units sold during 1902 was 17 per cent. larger than in the previous year. During the year the directors have had under consideration the question of important extensions of the generating station at Osney, and consulting engineers were employed to advise as to the best methods to be adopted. A part of their recommendations has been carried out by the provision of an additional bay to the generating station, capable of accommodating four large boilers, one of which has been installed during the year. In view of future developments, eleven houses surrounding the works have been purchased. The distributing mains of the company have been extended during the year in the Banbury, Linton, Northmoor and Woodstock Roads, and in St. John and Park End Streets. An additional transformer station has been installed at Staverton Road. The plant has been maintained in thoroughly efficient order, and during the year a new firebox has been fitted to one of the original boilers at a cost of £250. This expenditure has been charged against the reserve and renewal of plant account. Mr. Selby Bigge has resigned in consequence of private engagements. The board recommend that the vacancy be not, for the present, filled up.

Lancashire Electric Power Co.—Mr. F. E. Gripper, at the meeting held in London on the 24th inst., said the company was incorporated by Act of Parliament for the purpose of supplying electrical energy in bulk to authorised undertakers for their own use and for distribution throughout the manufacturing districts of Lancashire, south of the Ribble, with the exception of six county boroughs. The necessary capital for the equipment of the company's first station at Little Lever, near Bolton, and the laying of over 60 miles of cables on their proposed first line of route, had been practically assured. He expected that the contracts would be let in the course of the next few weeks, and the work would proceed with the utmost expedition. Next year he hoped they would be in a position to supply local authorities with electricity in bulk.

Crossley Brothers.—The report for 1902 states that the amount at the disposal of the directors is £102,519. After 5 per cent. is paid on the preference, and 11 per cent. on the ordinary, £19,615 is carried forward.

Western Telegraph Co.—The directors have declared an interim dividend, payable on March 23rd, of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended December 31st last. The transfer books will be closed from March 18th to 24th.

STOCKS AND SHARES.

Wednesday Evening.

Tightness in the Money Market and a flatness of the Funds do not prevent a considerable amount of business in the Electrical departments. The Home Railway department is again moving on a pivot of its own, and the public has developed another little buying mood. Electrical Supply shares continue to command increasing favour, and Telegraph descriptions still move timidly upward, as though half afraid to go ahead strongly lest the market should be swamped with stock.

The investor is coming to recognise the comparative cheapness of several Home Railway stocks in what is known as the "Heavy" section, and a feature of the week is the sharp rise which the Railway Market has to show. That the improvement should not have extended to Electrical Railway stocks is not surprising in view of the greater relative cheapness, say, of Great Western than Central London—cheapness, that is, from the point of view of return upon the capital invested. Those who essay to read the future, put Central London stocks upon a 5 per cent. basis, but the company has a lot to do before it can safely distribute such a dividend, and in the meantime the capitalist looks out for something that will pay more on the money at the present time. City and South London Ordinary has been down to 75 since we last wrote, but the price is firming up again, and the bogey of tramway competition in South London is perhaps played out for awhile. Metropolitan Consolidated and Metropolitan District stocks are both harder. Waterloo and City is quotably unchanged at 98½.

A number of interesting reports are issued this week by electrical supply concerns. The City of London Electric Lighting Co. shows that it made an extra profit of about £4,000 as compared with the previous year, and while this result has been treated as disappointing by some of the papers, in the market the result receives more appreciation. City shares are now about 10½. Chelseas keep a very strong market for some extraordinary reason. Negotiations are still going on for the extinction of the founders' shares, although so far the *pourparlers* have failed to discover a satisfactory way out of a difficulty which of necessity must be solved some day. And the solution, it may be suggested, is hardly likely to improve, at all events temporarily, the price of the existing Ordinary shares. London Electrics are also strong, all three classes coming in for a good deal of attention this week. Blackheath are ¼ better on the week.

With regard to dividends not yet declared, an idea prevails that the Notting Hill distribution will be at the rate of 6 per cent., and a certain amount of curiosity attaches to the coming report, because some say that the dividend will probably be helped by a draft from the reserve fund. The Metropolitan announcement may be expected any time within the next fortnight, and is usually one of the last to make its appearance. Much discussion still rages in Marylebone as to the likelihood of the borough being allowed to borrow the money after all.

With the passing of the latest Marconi scare has come a refocussing of investors' attention upon Telegraph stocks and shares. Those proprietors who have so eagerly thrown away their holdings, are now also to be numbered amongst the buyers, and as the market is none too well supplied with stock, the better tone remains in force. The changes this week are not so important as those chronicled in our last list, but the general trend remains bullish. Eastern Ordinary is a point lower; Extensions keep at 12, the company having secured an important order on its cable ships. A further spurt has taken place in West India and Panama varieties. As briefly noted previously, the Venezuelan difficulty has brought unlooked-for grist to the mills of the West Indian cable companies, and the revival of trade that is pretty sure to follow the settlement of the dispute is another source of hopefulness. Anglo-American Telegraph stocks are good, the Preferred being picked up as a fair speculative investment. Any outbreak of activity in Yankee Rails would probably mean a rise to par for this stock, but it must be admitted that the immediate outlook for the American market does not favour undue optimism.

Telegraph Constructions continue to receive support, and the report of the company, which appears in another column, is of a gratifying character. Movements in the Miscellaneous Market are few and unimportant, although there is an unwonted amount of trade doing in the general industrial department. National Telephone issues are steady.

British Electric Tractions display no change, but Potteries Ordinary are ¼ better at 9½. London United Debenture stock is up a point, and a hardening in Buenos Ayres and Belgrano prior stocks is perceptible. Beyond this, the tramway market displays little movement.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Feb. 18th.	Closing Quotations Feb. 25th.	Business done week ended Feb. 25th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	96 —100	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛ — 3⅛	2⅛ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
738,840	Anglo-American Telegraph	Stock	3½%	6⅛s.	6⅛/6	49 — 52 xd	49 — 52	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94 xd	92 — 94	93½	92¼
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8⅜ — 8⅝ xd	8⅛ — 8⅜	8⅜	8⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4 — 4½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	160 —170	160 —170	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	93½	92⅛
16,000	Cuba Telegraph	10	4½%	4 %	..	6¼ — 7⅛	6¼ — 7⅛	6⅞	..
6,000	Do. 10 % Pref.	10	..	..	..	13 — 14	13¼ — 14¼	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10½	10¼ — 11	10⅜	..
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —102	98 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	123 —128	122 —127	127⅜	124
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	86 — 89	87 — 90	88	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	..
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10¼ — 11⅛	11⅛ — 12⅛	12⅜	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	107 —110	105 —108	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102 %	100 —108	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	..	8⅜ — 9½	8⅜ — 9½	9	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13	12⅞	12¼
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	..	25 — 27	25 — 27	26	..
66,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	¼ — ⅜	¼ — ⅜	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	¾ — 1	¾ — 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	98 —100	99 —101	100⅛	99
1,966,667	Do. do. Def. Stock	100	..	..	4½%	70 — 72	70 — 72	72	70⅛
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅛	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5½	5 — 5½	5 5/16	5 1/16
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	95 — 97	96⅜	96¼
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅛	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	¾ — 1	¾ — 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½ — 7⅛	6½ — 7⅛	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	110 —120	105 —115	107	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	5⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	10 — 11	11 — 12	11⅞	11⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	..	..
88,321	West India and Panama Telegraph	10	⅛%	..	..	⅜ — ½	⅜ — ½	⅜	⅜
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	5½ — 5¾	6⅛ — 6¼	6⅛	6⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	4 — 5	4⅛	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13½ — 13⅝	13½ — 13⅝	13⅝	13⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12⅛ xd	12 — 12⅛	12⅛	12⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126½	126
100,000	British Insulated Wire Ord.	5	15 %	10 %	..	7⅞ — 8	7⅞ — 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	101	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	12/6 to 13/6	12/6 to 13/6	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	..	⅞ — 1⅛	⅞ — 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	..	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	91 — 96	91 — 96	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	14 — 15	13½ — 14½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½ — 6	5⅝ — 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	106 —109 xd	106 —109	..	..
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	103 —106 xd	103 —106	105⅛	75
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	109 —113 xd	109 —113	111½	110
1,330,000	City and South London Railway	Stock	1½%	2 %	3⅛%	77⅛ — 78½	76¾ — 77⅛	77⅛	75
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2⅝ — 3	2⅝ — 3	2⅞	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	⅛ — ¼	⅛ — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1⅝ — 2⅛	1⅝ — 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1¾ — 2	1¾ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅛ — 3	2⅛ — 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10⅛	10 — 10⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15½ — 16½	15½ — 16½	16	15⅝
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5¼ — 5⅝	5¼ — 5⅝	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½	18½ — 19½	19½	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	101 —104	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅛ — 11	10⅛ — 11	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14¼ — 15½	14¼ — 15½	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	38 — 41	38 — 41	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	100	..

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ From Bradford Share List.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—¼.
National Electric Free Wiring, ½—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Feb. 18th.	Closing Quotations Feb. 25th.	Business done week ended Feb. 25th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	‡ 1	.. .. ..			⅜—¾	⅜—¾	¾	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	.. .. ..			114 —117	115 —118	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 % 8 % 8 %			10½— 10⅝	10½— 10⅝	10⅝	10 7/16
20,000	Do. do. 7 % Cum. Pref.	5	.. .. ..			10 — 10½	10 — 10½	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 % 10 % 10 %			9 — 9⅛ xd	9 — 9⅛	9 7/16	9 5/16
70,000	Do. do. do. 4½% Cum. Pref.	5	.. .. ..			5⅛— 5⅜ xd	5⅛— 5⅜	5⅜	5⅛
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	.. .. ..			4⅜— 5⅛	4⅜— 5⅛	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	.. .. ..			103 —105	103 —105	104½	..
44,436	*Chelsea Electricity Supply, Ord.	5	5⅓% 4 % 4½%			6 — 6½	6 — 6½	6⅝	..
150,000£	Do. do. % Deb. Stock Red.	Stock	.. .. ..			108 —111	108 —111	108⅜	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 % 5 % 5 %			10 — 11	10 — 11	10⅜	10⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %			13⅜— 14½	13⅜— 14½	14	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	.. .. ..			122 —127	122 —127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	.. .. ..			102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 % 4 % ..			9 — 10	9 — 10	9½	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %			12 — 13	12 — 13	..	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	.. .. ..			108 —111	108 —111	110½	109
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 % 7 % ..			6½— 7 xd	6½— 7	..	..
30,000	Do. do. 6 % Cum. Pref.	..	.. .. ..			6 — 6½	6 — 6½	6⅝	6½
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	.. .. ..			106 —109	106 —109	108	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 % 10 % 10 %			10½— 11½	10½— 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	.. .. ..			100 —103	100 —103	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	.. .. ..			2 — 2⅛	2⅛— 2⅜	2⅛	2 1/16
49,840	Do. do. do. 6 % Pref.	5	.. .. ..			5½— 6	5⅝— 6	5⅞	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	.. .. ..			98 —101	99 —102	101	99⅞
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 % 6½% ..			18½— 19½	18⅝— 19	18⅞	18½
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	.. .. ..			108 —113	108 —113	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	.. .. ..			98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 % 6 % ..			14 — 15	14½— 15½	14⅞	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½% 14½% 14½%			14 — 15	14 — 15	14⅜	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,030	5	7 % 7 % ..			8½— 9⅛ xd	8½— 9⅛	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red	100	.. .. ..			97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	.. .. 2½%			2 — 2½	2⅜— 3	3	..
50,000£	Do. do. 4% Deb.	100	.. .. ..			80 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	.. .. 1½%			3⅛— 3⅜	3⅛— 3⅜	3 5/16	..
30,000	Urban Electric Supply, Ord.	5	.. .. ..			4⅛— 5⅛	4⅛— 5⅛	5 1/16	..
30,000	Do. do. 5 % Cum. Pref.	5	.. .. ..			4⅝— 5⅛	4⅝— 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½% 10½% 12 %			12 — 13	12⅝— 13¼	13	..
28,141	Do. do. 5 % Cum. Pref.	5	.. .. ..			6 — 6½	6 — 6⅝	..	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, February 25th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90%)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23 15	£23 15	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	3d.	..
a ,, Caustic (76/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	119/-	119/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70%)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b ,, Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£42 to £130	£42 to £140	..
c Brass (rolled metal 2' to 12') basis	per lb.	6½d.	6½d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	7d.	7d.	..
c ,, Wire, basis	per lb.	6¾d.	6¾d.	..
c Copper Tubes (brazed)	per lb.	8¾d.	8¾d.	..
c ,, ,, (solid drawn)	per lb.	9d.	9d.	..
g Copper Bars (best selected	per ton	£71	£71	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g ,, Rod	per ton	£71	£71	..
e ,, (Electrolytic) Bars	per ton	£61 10	£60	30/- inc.
e ,, ,, Sheets	per ton	£75	£74	£1 inc.
e ,, ,, Rod	per ton	£64 10	£63	30/- inc.
e ,, ,, H.C. Wire	per lb.	7¾d.	7¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/4½	1½d. inc.
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/9	3/5½ to 3/6½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	50/3	47/8	2/7 inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£12 7 6	£12 5 to £12 10	..
g ,, ,, Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 12 6	£8 12 6	..
d Mica (in ginal cases) small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2	1/- to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars		From £15	to £40	..
g Tin, Block	per ton	£135 to £136	£134 10 to £135 10	10/- inc.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals—"White Ant" brand	per ton	£38 to £60	£38 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7½d.	7d.	½d. inc.
j ,, 6 lea. Flax	per lb.	5½d.	5½d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4⅛d.	4⅛d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24	£23 10	10/- inc.

Quotations supplied by: a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons., Ltd. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by: f India-Rubber, G.P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by: k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys.	Feb. 20	649	+ 96	37,674	+ 4,681	12½	13½
Blackpool and Fleetwood	,, 21	201	+ 71	1,404	+ 253	7¾	7¾
Bristol Trys. & Car. Co.	,, 20	4,413	+831	—	—	28	28
British Elec. Trac. Co.:—							
Barnsley District	,, 13	176	—	905	—	—	—
Devonports	,, 13	374	+ 20	2,351	— 85	5	5
Dudley—Stourbridge	,, 13	717	+154	4,170	+ 384	18¾	18¾
Gateshead	,, 13	827	+244	5,0 9	+ 1,087	10¾	9¾
Gravesend—Northfleet	,, 13	184	—	1,058	—	3¾	—
Greenock—Pt. Glasgow	,, 13	277	+ 71	2,440	+ 238	7¾	7¾
Hartlepool	,, 13	220	+ 82	1,304	+ 265	6¾	4¾
Kidderminster	,, 13	100	+ 17	602	+ 51	4¼	4¼
Merthyr	,, 13	187	+ 1	1,0:1	— 133	3	3
Middleton	,, 13	227	—	1,384	—	8¾	—
Oldham—Ashton	,, 13	5 9	+135	3,175	+ 385	8	8
Peterborough	,, 13	147	—	475	—	—	—
Poole	,, 13	234	+ 68	1,871	+ 274	8¾	8¾
Potteries	,, 13	1,452	+197	9,147	+ 737	28¾	28¾
Rothesay	,, 13	37	+ 1	256	+ 69	—	—

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
B.E.T. Co. (*continued*)—							
Southport	Feb. 18	218	+111	1,297	+ 555	53	53
South Staffordshire	,, 13	731	+ 99	4,119	— 230	21¾	22¾
Swansea	,, 13	436	+ 76	2,717	+ 253	6¾	5¾
Taunton	,, 13	48	+ 2	295	— 21	1½	—
Tynemouth	,, 13	219	+ 68	1,249	+ 117	9¾	9¾
Weston-super-Mare	,, 11	26	—	140	—	2¾	—
Wolverhampton Dist.	,, 13	342	+107	2,027	+ 1,151	10	2¾
Central London Railway	,, 21	6,933	+296	55,573	+ 2, 89	6	6
City and S. London Ry.	,, 23	9,068	+ 44	20,381	+ 2,045	6¾	6¾
Doncaster Corp. Trys.	—	—	—	—	—	5¾	—
Dover Corporation Trys.	,, 21	170	+ 10	1,284	+ 10	3	3
Dublin United Trys.	,, 20	4,523	+862	31,123	+ 2,376	46	46
East Ham Tramways	,, 21	499	+197	17,175	+ 4,142	5	4¾
Glasgow Corp. Trys.	Jan. 24	11,629	+989	415,909	+ 2,301	62	50¾
Liverpool Overhead Ry.	Feb. 22	1,468	+124	11,859	+ 1,0 9	6¾	6¾
Newcastle Corp. Trys.	,, 21	3,006	—	—	—	35	—
Sunderland Corp. Trys.	,, 23	967	+ 60	—	—	17¾	17¾

* Compared with the corresponding period of 1901.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON ELECTRONS.

By Sir Oliver Lodge, F.R.S., Vice-President.

(*Paper read in London, November 27th*, 1902.)

(*Continued from page* 287.)

Radiation.

But it is not only the progressive motion or locomotion of the electric atomic appendages that we have to consider; we must assume also that they are susceptible of motion in the atom itself, either vibrating like the bead of a kaleidophone, or revolving in a minute orbit like an atomic satellite. Indeed it is to the vibrations or revolutions of the electrons in an atom that its radiating power is due. Matter alone has no perceptible connection with the ether, a fact which is proved in my paper in the *Philosophical Transactions* for 1893 and 1897*; it is electric charge which gives it any connection, and even then it has no *viscous* connection—there is no connection that depends upon velocity, or is of the nature of friction†—it is purely accelerative connection; it is only when the charge vibrates, and during its accelerative periods, that it is able to influence the ether and carve it into waves‡—waves consisting probably of alternations of shear, with no motion of the ether as a whole, but only a to-and-fro quiver of its equal opposite constituents over some excessively small amplitude—a kind of motion which constitutes what we know as radiation. It is not the atom pulsating as a whole which disturbs the ether, but the pulsations or vibrations, or the startings and stoppings and revolutions, of its electric charge. But normal or centripetal acceleration, involving nothing more than change of direction, is just as effective as actual change of speed. If an electric charge is able to describe a small orbit 400 billion times a second, it will emit the lowest kind of visible red light. If it vibrates faster, it will emit light of higher refrangibility; and the particular kind of radiation emitted by the atom of any substance, when in a fairly free state, will depend on the orbital period of its electrons, every frequency of vibration corresponding to a definite line in the spectrum.

But, if this be so, radiation must be susceptible to magnetic influence, for a revolving electric charge constitutes a circular current, and if a magnetic field is started into existence with its lines threading that circuit, it must, while it is changing in intensity, cause the speed either to increase or to decrease, and so will either raise or lower the refrangibility. If, then, electrons are revolving in every direction and a magnetic field is excited, during the rise of the field the pace of some will be increased and of some decreased, and this increase or decrease will not stop until the magnetic field is destroyed again.

Hence it would appear that if a source of radiation is put into a magnetic field, and its lines examined with a spectroscope, they should be doubled, some being raised in refrangibility, others lowered; or if any are left unaltered the line might be tripled, or if the motion was of a more complicated character the line might conceivably be quadrupled or sextupled, or any other change produced according to the character and complexity of the motion. At any rate, it would seem that the line must be affected somehow, even if it were only broadened. It happened, however, that when Dr. Larmor theoretically perceived this, and did the calculation for it in 1895 to see how much effect might be expected, he made the natural assumption not that an electron could move by itself on a comparatively stationary atom, as above described, but that the atom was itself pulsating or revolving or quivering in some way as a whole and carrying its charge with it. On this assumption, knowing what he did about the massiveness of an atom, he perceived that the effect would be too small to see; and inasmuch as Faraday had, with imperfect appliances many years ago, looked for some such effect—not then guided by theory, but simply with the object of trying all manner of experiments—and had failed to see anything, no fresh experimental attempt to examine the question was initiated; nor was the matter publicly referred to until, as hinted above, Zeeman, of Amsterdam, in 1897, with a powerful Rowland grating, and a strong electro-magnet, skilfully observed a minute effect, consisting in a broadening of the lines emitted by a sodium flame placed between its poles; and then at once Dr. Larmor wrote to me, saying that this must be the effect which he had expected, but thought must be too small to see. On receiving the intimation I immediately, with a little trouble, repeated and verified the experiment,§ and exhibited it at the Royal Society *soirée* in May that same year.

From this simple but important beginning the large subject of the influence of a magnetic field on the radiation from different substances has been laboriously worked at, not only by the original discoverer, but by Preston in Dublin, Michelson in America, and others, and a whole series of important facts have been made out. Every line has been studied separately; some lines are quadrupled, some tripled, some sextupled, and so on, as said above. One mercury line is resolved into as many as 11 components. The effect is therefore *not* too small to see, though it needs excessively high power and perfect appliances to see it; and so it became evident that if radiation were due to moving electrons, their motion could not be handicapped by having very much matter associated and moving with them. It became possible, indeed, by making a measurement of the amount of doubling undergone by the lines in a given field, to ascertain how much matter was associated with the revolving electric charge in any given case; in other words, to make a determination of the electro-chemical equivalent effective in radiation, *i.e.*, of the ratio m/e. Indeed, Prof. Zeeman, with considerable skill, made a rough determination of this kind at a very early stage, when he only saw the effect as a slight broadening of the sodium lines; and came to the conclusion that the electro-chemical equivalent was quite different from that appropriate to electrolysis, being some thousand times smaller. He found, in fact, that the ratio e/m had in this case also the notable value already suspected in connection with cathode rays, viz., the value 10^7 c.g.s.

More recent measurements have confirmed this estimate, and shown that the ratio of charge to matter in the Zeeman case is practically identical with the ratio of charge to matter in the cathode ray case; in other words, that whatever is flying in the cathode rays is vibrating in a source of radiation, and that if the cathode rays consist of moving electrons, radiation is due to vibrating or revolving electrons.

Even this, however, does not constitute a proof of the existence of masses so much less than atoms; it may be only a remarkable coincidence. Besides, it is possible that in all these cases the whole atom is, after all, moving, but that its electric charge is 1,000 times bigger than what had previously been observed as the proper charge of an atom.

But this assumption, improbable even for the cathode rays, becomes still more unlikely in the case of radiation, where it is not at all unnatural that only a very small part of the atom should be moving, the great bulk of it being practically stationary. Besides, the more the details of the Zeeman effect are studied, the clearer it becomes that the electron theory attributed to it from the first by Prof. H. A. Lorentz, as well as by Fitzgerald and Larmor in England, is complete and satisfactory.

One of the earliest publications in England, both of the fact and of its elementary theory, is that given by the present writer in two articles in the *Electrician* for February and March, 1897,* which are worth referring to as representing incipient ideas on the subject before the full significance was grasped. The high value of the e/m ratio, viz., $\frac{1}{2} \times 10^7$ c.g.s., or 50 million coulombs per gramme, instead of the moderate electrolytic value, is spoken of on page 643 as a difficulty, and a Fitzgerald suggestion amounting virtually to the beginnings of an electron theory of the Zeeman effect is hinted at. Likewise an extremely short way of expressing the theory of the motion is given by the writer, in the following form:—

Consider the resolved part of any orbital motion projected on to a plane normal to the applied magnetic field, H, and let the angular velocity at any point with radius of curvature r be ω, then the field will exert a radial component—

$$\pm \mu e H r \omega,$$

which will represent an increment or decrement of centripetal force

$$d(m r \omega^2),$$

whence it follows, to a first approximation, that—

$$d\omega = \pm \frac{\mu e H}{2 m},$$

and the change of frequency caused by the magnetisation will therefore be—

$$\pm \frac{\mu e H}{4 \pi m}.$$

The other component of the original orbit will manifestly be unchanged. This is far from being a complete and satisfactory theory, unless the projected motion happened to be circular; but it was a brief and early attempt.

On the Electron Theory of the Magnetisation of Light.

Among the early contributions that have been made to the theory of moving charges, few are more remarkable than those of Dr. Johnstone Stoney in connection with the process of radiation, long before there had been any experimental verification of the separate existence of these electrons, or of the fact that the emission of light from a substance is due to their motion. Dr. Stoney had treated them in an astronomical manner in 1891, dealing with an electron moving round an atom as if it were a satellite moving round a planet, and had discussed the various perturbations to which they might be subject, and the effect of those perturbations on the spectrum of the light emitted.

One of the simplest kinds of perturbation is what is called a progression or recession of the apses, being a slow revolution of the orbit in its own plane. Such a motion was shown to be able to account for a doublet in the spectrum; for of the two component vibrations into which the motion can be analysed, one has been made more rapid, and therefore its light raised in refrangibility, the other has been made slower and therefore lowered in refrangibility.

Another closely allied kind of perturbation, analogous to precession of the equinoxes in the case of the earth, would result in a line triplet in the spectrum. This precessional motion occurs in an orbit subject to any oblique pull or deflecting force. Instead of yielding directly to that pull, its effect is to make the axis describe

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* Lodge, *Phil. Trans.*, Vol. 184, pp. 727—804, and Vol. 189, pp. 149—166.

† See especially *Phil. Trans.*, Vol. 189, p. 164.

‡ See Part I. of this paper, also Appendix G.

§ See *Proc. Roy. Soc.*, Vol. 60, pp. 466, 513, and Vol. 61, p 413; or *Nature*, Vol. 56, p. 237; also the *Electrician*, Vol. 38.

* See Lodge, *Electrician*, Vol. 38, pp. 568 and 643.

a kind of cone, the kind of motion that one sees in an inclined spinning-top; the pull of gravity on a spinning-top does not make it topple over, but makes it precess. So also with a hoop or bicycle when not vertical; instead of tumbling, it turns round and round in a circuit as long as its motion continues; only falling when the motion ceases. Hence if the orbit of an electron were subjected to oblique or deflecting force, the effect would be not to place it directly in the desired position perpendicular to a line of force, but to cause it to precess; and this motion might be analysed into three, the acceleration and retardation of circular orbit above-mentioned, which would result in a doubling of the line, and a third component, viz., the one parallel to the axis, which would be unchanged, and would therefore represent a spectral line in its old position, the centre of the group of three. All this was clearly perceived by Larmor and Fitzgerald in connection with Dr. Zeeman's discovery, though they were anticipated by his great compatriot the eminent physicist, H. A. Lorentz; to whom the most complete publication of the theory is due, being in several respects anticipatory of the experimental results. For it may be observed that the light emitted by the oscillation components above spoken of will be all of one definite kind, due to vibrations in one definite direction and therefore polarised. The kind of polarisation would depend on the aspect from which it was seen. If seen at right angles to the axis of precession, all three lines should be plane polarised, the middle line at right angles to the other two. If, however, it be looked at along the axis of precession, then there should be no middle line, because the axial vibration would then be end on; and the two side lines should be circularly polarised.

Directly Zeeman had demonstrated the fact that a magnetic field applied to a source of light was able to act as a perceptible perturbing cause, Prof. Lorentz was at once able to predict the whole of that which has been here stated about the tripling of the line seen sideways to the lines of force, and the doubling of the line seen endways, with all the polarisations as just stated; because the lines of magnetic force constitute the precessional axis. And all these effects were shortly afterwards seen by Zeeman and others, and are characteristic of the simplest circular orbit.

At first sight one might be inclined to suppose that the orbits would all face round and set themselves normal to the lines of force, like so many circular currents; but that is to forget the inertia of the travelling electron. It is manifest that since a revolving electron constitutes a circular current, its *tendency* will be to set itself with its plane normal to the lines of force; but since by hypothesis the revolving electron has inertia, the current will not so set itself, but will yield to the deflecting force in an indirect manner as a top does; or as the oblate spinning earth does—as explained by Newton in the Principia—the axis of rotation having a conical motion round the lines of force, a motion which is called the precession of the equinoxes in the case of the earth, and the Zeeman effect in the case of a radiating atom.

This is an account of the chief part of the Zeeman effect, and may be regarded as the most fundamental kind of disturbance caused by a magnetic field on a source of radiation. But there may be other minor disturbances, just as in the case of the earth, whose axis is not only subject to precession, but also to nutation—a nodding movement superposed upon the main motion. It is also quite possible for the middle line, or for the two outer lines, or indeed for all three lines, to be doubled; thus giving rise not to the standard triplet, but to a quartet or a quintet or even a sextet—appearances seen and photographed for some lines of some substances by Preston.

Even the two constituents of the double sodium line behave differently: one of the sodium lines, D_2, which had appeared only broadened to Zeeman at first, really becomes a sextet. The other sodium or D_1 line becomes a quartet; and a complete study of the behaviour under magnetism of all the lines and groups of lines given by different substances must result in a great extension of our knowledge in many directions; in fact, it is hardly too much to say that the discovery of Zeeman, in the light of the theory of Lorentz, has doubled the power of spectrum analysis to throw light upon the processes of radiation and the properties of atoms, and has opened up a new department, as it were, of atomic astronomy, with atoms and electrons instead of planets and satellites.

(To be continued.)

MANCHESTER LOCAL SECTION.

THE reading of Mr. J. S. Highfield's paper on "The Possible Developments of Electrical Driving in Factories, due to the Supply of Electricity at Cheap Rates by large Power Companies," was delayed through the author's illness until Tuesday, February 17th; this is also given as an explanation of the incompleteness of the paper. The object aimed at was to touch on the salient points of the subject, rather than enter into it in detail, and thus provide material for a ready discussion.

It is important to bear in mind the intrinsic difference between electric light undertakings and power supply schemes. The former were primarily put down to supply electricity for lighting, the power load being a development, whereas the latter are designed to supply electricity mainly for power purposes, the lighting load being only of secondary importance.

We have long insisted on the necessity for allowing the use of overhead wires for economical transmission and distribution of power, and Mr. Highfield strongly supports this view, giving the comparative costs between underground cables and overhead wires as follows:—

Overhead wires, total cost per mile for two wires	=	£400
Underground cables	"	" cables	= £700

These costs are for two ·2 sq. in. conductors, the underground cables being paper-insulated, lead-covered, and laid in troughs. The poles for the overhead wires are sufficiently strong to carry eight similar conductors, and as each pair of wires is added, it will be seen that the cost for a given capacity of the overhead line becomes increasingly less than the cost of the underground line.

The cost of supplying electricity is largely dependent on the load factor, and whereas the standing charges are controlled by the annual load factor, the cost of fuel, oil, stores, &c., are mainly influenced by the weekly or monthly load factor. It is interesting to note that the monthly load factor may be higher in summer than in winter. The importance of advising as to the best methods of driving, is recognised by Mr. Highfield, and he advocates a trained staff to study the problem, and give information on the most suitable method of adapting motors to any particular class of work.

Probably engineers have to some extent lost sight of the true relationship between cost of power and the final cost of the manufactured article; also, in competition with existing methods of driving, they have laid too much stress on the primary cost of the power, instead of showing the possibilties of increased output. For processes requiring a steady drive the electric motor is excellent, and even where the power will cost more, the extra profit accruing from increased output may far outweigh the extra cost of power. In paper-making, printing, and textile factories particularly there may be openings not yet altogether appreciated.

The managers of collieries have not been slow to realise the many advantages of electricity as applied to mining operations, and a large number of mines are working by electric power. There is, however, much room for development, particularly in "winding," and though the difficulties to be overcome are great, they are not insurmountable, and the application of electricity would result in economy in winding costs and an important load for power stations.

Great impetus has been given to electricity supply by the hiring out of motors, and in many cases the saving in capital outlay has largely influenced the adoption of electricity.

The paper concludes with a brief review of existing methods of charging, and Mr. Highfield thinks it probable that that of giving discount on quantity or some arrangement of special contracts will be the method generally adopted.

The CHAIRMAN (Mr. Earle) opened the discussion. He pointed out that power companies, though finally to own extensive schemes with large capital, would not complete these schemes or employ the whole of the capital at once. In a given case, with a capital of, say, £2,000,000, probably the first instalment of plant and mains would cost £500,000, and on this it is estimated a dividend of 5 per cent. would be paid. When the whole capital was employed this dividend would be 10 per cent. He fully agreed with Mr. Highfield that the importance of overhead wires was very great, and if used when a power scheme was first put in operation, they would enable 1½ per cent. more dividend being paid, which was important, in that it would considerably help the raising of further capital. Board of Trade consent to overhead wires might be obtained, say, on a yearly agreement, whereas such privilege for perpetuity might not be granted. Power companies anticipated spending £15 per KW. on cables to begin with, but with overhead wires this could be reduced to £5 per KW. The cost per KW. for a scheme of 10,000 KW. capacity worked out at £37 per KW., which was divided into £16 per KW. for distribution, and £21 per KW. for the generating station. He questioned the correctness of the figure (·02d. per unit) given for the running cost of the water-power scheme; that of £4 per horse-power per annum could just be done in England, assuming a 100 per cent. load factor with coal at 6s. 8d. per ton, but without paying interest on capital. In the case of a cotton mill where extensions were being made, and steam driving would have involved extensive structural alterations, it had been found advantageous to adopt electric driving. Where separate engines were used in outhouses, there would be no doubt of the economy of electrical operation. The steadiness of the drive was most important, especially for paper-making, and in one instance when steam was used trouble had been experienced through the paper constantly breaking; with electrical driving this trouble was overcome. The difficulty of raising capital in many undertakings had driven the promoters to apply to the power companies for a supply of electricity. He doubted if the demand indicator had come to stay; in most cases of large companies contracts had been arranged to supply at a given price per unit. Like the author, he thought that small plants would be entirely superseded by power companies.

Dr. BOWMAN said that, unless the cost of supply could be very greatly reduced, there would be no chance of getting the large demand for power that was possible. He had been able to produce electricity in a private gas-driven plant at 30s. per H.P.-year. This was based on the allowance for the bye-products at market value. When these had been allowed for, 16-C.P. gas did not cost them 1d. per 1,000 cb. ft. Where the number and size of motors were small and the demand intermittent, undoubtedly electricity from the power companies was the cheapest; but where this was supplied at the very lowest cost it would not compare with the large private plant as stated above. He had recently to deal with a case where a large number of old steam engines had to be replaced. Gas engines were adopted, and the saving was found to be 75 per cent. compared with the price that would have been paid to the supply company. The two-rate system of charging was unsuitable in any important manufacturing district. It was unlikely that large engines for driving textile mills would be replaced unless energy could be supplied at ¼d. to ⅜d. per B.T.U.

Mr. COOPER (Colne) raised the point of the value of the bye-products of gas making being reduced through the greater supply that would result from the general adoption of gas power. Elec-

tricity for winding in collieries offered great difficulties; a steam winding engine he was acquainted with had a 48-in. diameter cylinder × 72 in. stroke, and would require a very large motor to replace it. The problem of continuous winding was being worked on, and should this be solved it would be a great step in helping to the adoption of electric working. When advocating the use of electric motors from the standpoint of economy, he found that various firms preferred to spend their capital on improving their tools and other plant, rather than on electric driving. The maximum demand system for motors was disastrous to the indicators, especially on short circuits. An interesting case was cited, where, before electricity was introduced, three boilers were used to supply the steam to the various engines; afterwards one boiler did the whole of the work.

Mr. C. D. TAITE was glad to have the opportunity of saying a word on the load factor. Some time ago he criticised Mr. Earle's figure of 25 per cent. estimated for power companies. He now found the load factor in the Salford power station to be 30 per cent., the lowest during the previous summer months being 26 per cent. The price at which electricity could be supplied was fixed not by the daily or monthly, but by the annual load factor. It was found in Salford that electricity could be produced at rather under £4 per H.P.-year. Emphasis was laid on the importance of explaining to power users the advantages of electricity. It was remarkable what great ignorance there was, especially amongst small users, of what their power was costing them, and of the subject of power supply generally. Speaking of methods of charging, he did not like demand indicators owing to the trouble they gave. If the supply of electricity was to become universal a simple system of charging should be adopted. The flat rate, with carefully arranged discount tables, was, perhaps, the best.

Mr. COWAN congratulated Mr. Highfield upon having obtained the Board of Trade sanction for overhead wires. Thirteen years ago he was responsible for the erection of some overhead wires to carry 2,000 volts, which had been passed by the Board of Trade. An advantage of electric driving was that during times of slackness, the expenses of power could be greatly reduced. In negotiating for water-power, he advised approaching the matter diplomatically. In one instance the owner of a water-power had been asked to join the company's board, and without further trouble the price was arranged at 10s. per H.P.-year.

Mr. FEITH explained what he understood was meant by the author on the rating of motors in a way different from that at present employed. He took it that whereas one motor might be running at full load for 24 hours, another would only have to take the peaks of the load occasionally for a very short time. If one but knew the work motors had to perform, they could be designed suitable for that work; it was simply a question of knowing what was wanted. Crane-motors which were only worked intermittently, had yet to stand the test, specified by consulting engineers, of running long hours at full load with only a certain temperature rise.

Mr. WILLIS took it that the author meant putting in different classes of motors for different work. For instance, with a planing machine the consumers had insisted on having an 8-H.P. motor fixed to drive it. This sparked badly and blew the fuses at each reversal of the table, and finally a 23-H.P. motor had to be fixed. A fly-wheel was suggested and adopted, with the result that a 7-H.P. motor was satisfactory for the work. Many manufacturers were discouraged by the bad application of motors, and he thought the suggestion of experts to advise manufacturers was a good one.

Mr. DOUGLAS spoke of the generating costs, and the possibility of running with gas engines. The thermal efficiency of the gas system was double that of the steam system, thus, apart from the question of bye-products, the fuel consumption would only be half, which would make a large percentage of difference in the generating costs. The price given of 8s. per ton for bye-products was misleading, and should be taken at 4s. 6d. per ton.

Mr. CHATWOOD gave some interesting figures. In an instance that came under his notice, the shafting load was 13 H.P., the useful load 2·6 H.P., and the maximum indicated load 2 I.H.P. The cost of steam for driving worked out at £360—£400 per annum. There could be no doubt about the economy of electric driving in this case. It had been said that it was impossible to get the load in cotton mills, but he would point out that the question was one of output, and that, with existing methods, the speed variation was 6 per cent.: with a steady drive the increase would be very great, and the profit on this increased output alone would probably pay the whole cost of the power. Further, the present load of supply stations was made up mainly of lighting and traction, but if a number of mills could be arranged with to take the load, the cost per unit would be further reduced. The best system of charging was a standard fixed charge and so much per unit. Mr. Highfield advised power companies to keep a special staff to advise on the application of electric power; this might lead to better results, but what about consulting engineers, would it be right to them?

Mr. HIGHFIELD briefly replied to the points raised. More knowledge was wanted of the proportion of the cost of power to the total cost of the manufactured article in various industries. The length of time for the overhead wires fixed at St. Helens was unlimited, and the only regulations to be observed were: First, they had to be securely fixed; second, they must be attended to so as to prevent their coming down. Temporary permission might be a means of getting in the thin end of the wedge, but it might lead to trouble; the permanent arrangement was the best. Load factors usually given were calculated on the maximum winter load; this was not wanted so much as the weekly or monthly load factors. Batteries increased the load factors in the station, and where fixed in sub-stations increased that on the mains also. Two speakers had cleared up the difficulty of the different rating of motors. For intermittent work ordinary motors were not suitable and should be designed as traction motors were, capable of taking heavy loads for a short time. The figure he had given, ·02d. per unit, for the water-power scheme was correct, it included all charges for generation, but not, of course, for distribution. Chemical works would be better advised to set themselves up by the side of power companies' stations, rather than that power stations should be put down near chemical works. Without being drawn into a discussion on systems of charging, he thought the demand indicator would not last. The difficulty was to find a better system, and if the suitably arranged discount system were introduced, it would receive consideration; but it presented many difficulties. The system to be used must be based, first, on the load factor, and, second, on the cost of generation. It is important to instruct the user in his requirements; the electrical engineer's business was to explain to him the best thing to use, as almost invariably he did not know anything of the problem. The system of having a special staff to advise worked well; if consulting engineers would learn to do this work, station engineers would be relieved of the trouble—if not, then someone else would have to do it.

A vote of thanks was given to Mr. Highfield, and regret expressed that he would soon be lost to this section of the Institution.

LEEDS LOCAL SECTION.

THE inaugural address was delivered to the Leeds Section of the I.E.E. by Mr. Harold Dickinson, A.M.I.C.E., the first President, on Thursday evening, February 19th, and dealt, first, with the objects and advantages of the Society, and, secondly, with our commercial and educational problems. Mr. Dickinson remarked that attempts were made to form an electrical engineering society in Yorkshire some 19 years ago, but fell through, owing to the limited number of persons interested in the business in those days. Now, however, such a body has come into existence as a section of the parent Institution, and enters upon its career with 181 members, being the second largest section in the United Kingdom. Mr. Dickinson holds that one of the chief duties of the Institution in the future is to counteract the notion of our Colonies that the electrical industry at home is in a worse state than is actually the case, a notion which has arisen through the reproduction in Colonial journals of exaggerated and pessimistic reports published in our own daily press. With this object, electricians must support the Institution, not merely by paying their subscriptions, but by reading papers, and by taking part in the subsequent discussions. As regards the future of the industry itself, it is noteworthy that there is now no longer any difficulty in obtaining capital for electrical schemes which show reasonable prospects of success; but Mr. Dickinson utters a word of warning about the numerous power schemes of which so much is being heard at the present time. It is hopeless to expect low manufacturing costs unless a power scheme has a good load factor, yet many of these enterprises are designed to supply immense areas and very scattered districts, so that heavy distribution costs will be involved. Mr. Dickinson does not desire to discourage any scheme which may benefit the electrical industry, but he points out that if a number of these schemes is unsuccessful, it will shake the confidence of the investor.

Until quite recently the British capitalist and manufacturer have ordered their affairs by precedent; but in view of the ever-changing conditions of commerce, a new precedent is scarcely established before the environment of commercial life renders it antiquated, and, indeed, "precedent" ought to be, broadly speaking, a dead word. Foresight is more required. Some years ago it was patent to everybody who considered the subject that larger electrical generating units would be required in central stations; but our manufacturers neglected to lay themselves out to supply the demand, and in consequence many of the largest sets had to be procured from foreign firms. Moreover, with one exception, our British manufacturing concerns are too small, and provided with too little capital, to undertake large contracts in competition with American or Continental electrical firms; and so the bulk of the orders for the electrical equipment of railways and of the largest power schemes have gone to foreign firms, or firms of foreign origin. Technically, the English companies could have done the work as well as, or possibly better than, the foreign concerns, but for financial reasons they were unable to undertake it. Mr. Dickinson is not prepared to lay all the blame for restricted output upon the British working man; the fault is rather that of our paying time wages, instead of paying the employés liberally on a bonus or premium system. Mr. Dickinson believes in the brain of the workman, and ascribes to it his refusal to give the manufacturers "something for nothing." Mr. Dickinson desires to see the art of advertisement more elegantly cultivated in our country, "one particular rival" overdoes it, but we underdo it; and our manufacturers should seek to approach a possible customer by careful and attractively written letters and by the ingenious ways of their representatives.

Coming to the subject of education, Mr. Dickinson endorses much that was said by Prof. Clapham (who had been appointed to take charge of the scheme of higher commercial education to be given at the Yorkshire College) in a speech delivered at Leeds last November under the auspices of the West Chamber of Commerce. Students ought to be given as thorough a training as possible in the recent commercial and industrial history of Great Britain, in the bearings of business and trade in national prosperity, in the general causes which influence wages, rent, profits, and the like; in the relations between Government and national industry, between legislation and trade and labour in the elements of banking, currency, &c.; in the phenomena of the money market, of international trade, financial

crisis, trade depression, methods of combination, and the work and ideals of trade unions; in questions of railway freights, public finance, local and national—in general the business side of politics. Commercial geography must be taught properly, together with the bearing of geographical position upon international communication.

The whole fiscal policy of our country needs to be carefully and thoroughly studied, to see whether or no "Free Trade" is advantageous. Foreign firms always feel safe in erecting large factories, because they know that they can definitely command their own home markets, and can compete on practically equal terms in ours. The British manufacturer, in present conditions, has to endure increasing fiscal and other restrictions when attempting to sell abroad, and is not even secured in his own country. Mr. Dickinson does not desire to dogmatise upon the question, but asks whether the increased price of necessaries which might arise if we adopted some measure of protection could not be covered by the extra work the country would obtain and the higher wages it might pay, other possible grievances being met by a system of profit sharing. Mr. Dickinson is no pessimist. If we have not kept abreast of times, the cause has been one which might well have made others lax. For solid good work the English manufacturer is unequalled. He is now wide awake; and if to his new interest in technical education he will only add a study of inter-trade problems, and pay his men well by results, the prospects of the country will be as bright in the future as they have ever been in the past.

THE EDISON STORAGE BATTERY.

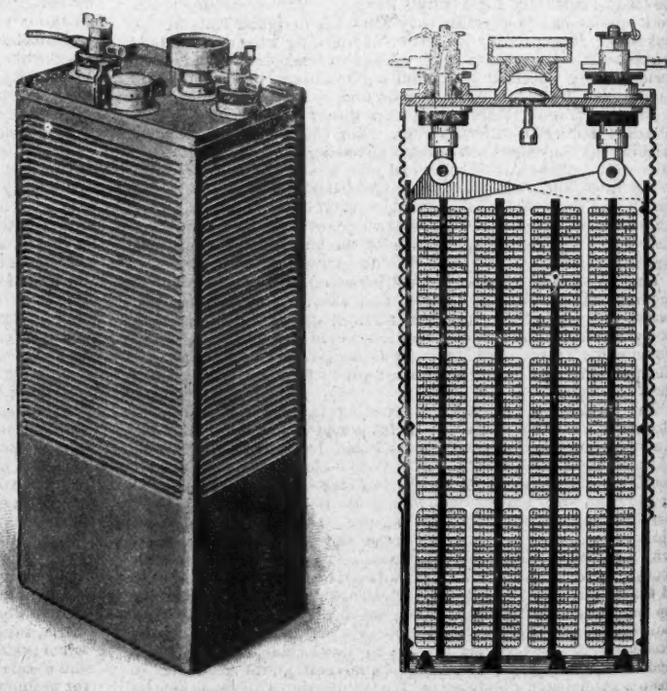
The crate of cells of the Edison nickel-iron storage battery, exhibited recently at the New York automobile show, gave the public a good idea of the general appearance and mechanical construction of the new cell, which, says the *Scientific American*, from whose columns we extract the following, is in several respects a great improvement over those of the lead type in use to-day.

In the first place, the jar used is of sheet steel, corrugated to strengthen it for about two-thirds of its height. The plates fit tightly in the jar, with their vertical edges pressing against hard rubber side frames that have properly spaced grooves to receive them. They rest on four suitably-grooved hard rubber wedges, and are separated by hard rubber strips. All the hard rubber parts are shown in black in the diagram, and thus can be readily distinguished.

The plates themselves consist of very thin sheet-steel frames, into the "windows" or slits of which are hydraulically pressed briquettes of iron and graphite or nickel and graphite (according to whether the plate is a positive or a negative), covered with perforated, steel retaining lids. The positive plates are all connected together within the cell and fastened to the positive terminal, which is brought out through a rubber bushing in the cell cover. A nut, held from unscrewing by a cotter key, clamps the connecting wire to the terminal, outside the cell. The negative terminal is brought through the outer side of the cover in the same manner, and connected outside to the positive one of the adjoining cell.

There are two other openings in the cover of the cell—one for filling it, and one for allowing gas to escape. The former has a hinged spring cap that opens upon releasing the catch. The gas valve has a mushroom-shaped top that, should the cell be over-turned, closes the two small gas passages in the gauze-fitted cap over it, and effectually prevents any liquid from escaping. The fine wire gauze, operating on the principle of the Davy miner's lamp, keeps the gas from firing back and blowing up the cell, should any of that which escapes become ignited. The cell cover fits sufficiently close upon the top of the jar to make a fluid and gas-tight joint.

The cells exhibited were of 200 watt-hours capacity, they being capable of furnishing 160 ampere-hours at an average discharge voltage of 1·3 per cell. They can be run down to 0 without damage, but ordinarily are not discharged below 0·75 volt per cell. Each cell has 24 plates $9\frac{3}{8} \times 4\frac{3}{4}$ in. in size and 0·1 in. thick. These plates are capable of discharging at as high a discharge rate as 200 amperes without damage. A sample plate was shown, taken from one cell of a set that had run a vehicle 3,100 miles over bad roads, and the only thing that distinguished it from a new plate was a slightly yellow colouration of the nickel-plated grid and briquette-retaining covers. The briquettes of active material appeared to be in very good condition, thus showing the cell to have a very long life and to be durable. More tests of the new battery are being made on delivery wagons in New York, after which, we understand, it will be placed upon the market this coming spring. One thing is certain, viz., that in the mechanical make-up of his cell, Mr. Edison has made so many improvements over the usual hard rubber jar as to produce a battery very much cleaner, neater, and safer than any that has yet been made. Even in the simple operation of refilling the cell by the addition of water, to replace any that should evaporate from the electrolyte owing to overcharging, provision has been made that the jar should not be filled too full by devising a funnel with a tell-tale float that indicates when the liquid has reached the proper level.



The Edison Storage Battery.

METHODS OF SPEED CONTROL FOR INDIVIDUAL MOTOR DRIVING.

In a recent issue* we reviewed, under the above title, two papers read before the American Institute of Electrical Engineers, and remarked upon the numerous American *systems* of speed control in vogue, and on paper. We now find from more recent publications that, in addition to the two papers referred to, no less than four others were read, all dealing with the same subject.

Each author considers his own pet system far and away superior to all others, and comparative efficiency curves are given by some to support their opinions.

Mr. Storer, who advocates the Westinghouse three-wire system, claims for it a steadier control than is possible with any system in which the armature voltage is varied, not excepting the multi-voltage control, of which he says:—"At no point of the curve does its efficiency equal that of the three-wire system." Mr. Lozier, on the other hand, in recommending the multi-voltage method, gives comparative curves of efficiencies, in which he credits this system with an efficiency of nearly 80 per cent. at quarter load, $87\frac{1}{2}$ per cent. at half load, and 90 per cent. from four-fifths to full load.

Following Mr. Lozier comes Mr. G. W. Fowler, claiming wonders for the C.C. "series-parallel" system. The series-parallel system is, of course, open to anyone to use, and, as a matter of fact, has been extensively used for years. The C.C. speciality appears to be in the controller. In all series-parallel arrangements the critical point is in changing over from parallel to series, without stopping the motor.

We once travelled almost the full length of England to investigate the cause of the repeated "blowing" of a fuse and flashing of the controller in connection with a double-wound motor. It was found that at the point where the connections changed from parallel to series the contacts arced over, thus putting the commutator in parallel and in series simultaneously. This, of course, means a dead short circuit, hence the blowing of the fuse. The C.C. Co. get over this by effecting the change by means of two automatic solenoid switches, which first open the circuit and then change over. The solenoids are actuated through the controller. By a combination of series-parallel and shunt control, all effected by one handle, a high efficiency is claimed; and curves of comparison between this system and the series rheostat method of control are given, in which, of course, the C.C. shows to advantage. So, obviously, would any other system.

Then comes Mr. H. B. Cono with a storage battery method. This is really a multi-voltage system, with tappings taken from various points of a battery instead of from a multi-voltage gene-

* December 26th, 1902, pp. 1055-6.

rator. The outer ends of the battery are connected to the mains so that a small charging current is always flowing. How it is proposed to keep the various sections of the battery equally charged is not described, nor does the diagram of connections help us. We are told that although the battery method is 30 per cent. more expensive in first cost than a multi-voltage generator, its increased efficiency on a variable load makes it worth consideration. This supposed increased efficiency appears to be based upon the idea that counter-electromotive force cells afford a very economical means of absorbing voltage. The author says: "The cutting down of supply voltage by counter-electromotive force is the natural method dictated by economic considerations, whilst to cut it down by resistance is unnatural." How this fallacy, which has obtained a very widespread credence, arose, we do not know, but it is really astounding to see it seriously discussed by scientific institutions. It is perfectly obvious that a supply company's meter would not give a consumer any credit for using back-E.M.F. cells in place of resistances.

Mr. H. Ward-Leonard next described an improved method of "Multiple-unit Voltage Speed Control" for trunk line service.* After referring to his 1894 paper, in which he described the transmission of a high-tension single-phase alternating current, with transformers and variable voltage control apparatus on the locomotive (a system recently fully described in Messrs. Mordey and Jenkin's C.E. paper), he outlined the improvement which consists in the application of this well-known system to multiple unit control. The author claims the following advantages:—(1) Heavier trains may be hauled over existing railroads; (2) a reduction in the maintenance of locomotives; (3) ditto for the permanent way; (4) increase in weight of train hauled round a given curve, with a given weight in the drivers; (5) ditto for a given grade; (6) reduction of dead load; (7) increased traffic as compared with series-parallel and cascade systems; (8) unlimited power under the control of a single driver; (9) 50 per cent. of energy now wasted in braking might be saved by restoring energy to the line; (10) smaller initial cost than with any sub-station system; (11) reduced cost of haulage per ton-mile; (12) electrolysis troubles minimised. These are Mr. Ward-Leonard's claims for his system, and in the face of such extreme modesty, it would be in bad taste to offer any criticism.

Following Mr. Ward-Leonard, Mr. F. O. Blackwell contributed a paper on the driving of machine tools by continuous-current motors. He points out that such machines as planers, slotters, milling cutters, and the like, require very little speed control, not more than, say, a 2 to 1 variation; whilst lathes, boring mills, and other revolving tools, require 8 or 10, or even 40 to 1 variation.

The various methods of control, such as series and shunt rheostats, three-wire and multiple voltage, are then discussed. As the same power is required to remove a given amount of metal per minute, regardless of the speed of the machine, motors used for such tools must give their maximum power at the lowest speed and voltage. Clearly, then, it is advisable to keep the lowest voltage as high as possible for the sake of economy in cables.

With a three-wire system and a 100 per cent. shunt control, a speed variation of 4 to 1 can be obtained. By means of a few gear changes, say a back-geared lathe, with a 4 to 1 gear, the total range is increased to 16 to 1, and with a double-gear a ratio of 64 to 1 is possible without increasing the motor cost. By using the ordinary step-cone pulleys, and a variable speed motor, with just sufficient range to fill in between the mechanical steps, the output of a machine can be increased by over 50 per cent. Thus, in an actual test, a motor-driven lathe performed a cut in 31 minutes which took 59 minutes when mechanically driven.

Then the facility of control is such that higher cutting speeds are unconsciously attained with motor-driven tools. The greater the range of speed control the larger the motor required; thus, taking as the standard size a motor arranged for a 2 to 1 variation on a two-wire system, it would necessitate a motor twice the size for a 4 to 1 variation on a three-wire system; four times the size for a 100 to 16 variation, and six times the size for a 100 to 12 variation on a four-wire system. By "size" is meant the horse-power rating at full speed and voltage. In addition to the extra cost of motors must be reckoned that of the wiring and special generators or balancers.

The author expressed the opinion that the four-wire generator must have sufficient current capacity at the lowest pressure to run all the motors that could ever be in service at one time at their full horse-power at that pressure. Counting upon the cost of special generators, extra heavy wiring, and increased size of motors, he said the four-wire system would cost several times as much as a three-wire system, and for ordinary purposes he considered a 2 to 1 variation on a two-wire, or a 4 to 1 with a three-wire, ample. This coincides with the views we expressed in reviewing the previous papers, and we still think that there is a risk of pushing this question of speed control too far, that is, to a point at which the complication and expense of installation and upkeep may cost more than the saving effected, and so a revulsion of feeling may arise against electrical driving. After all, simplicity has an appreciable market value. A point to be borne in mind is that existing machine tools built for certain maximum speeds will not for long stand speeds greatly in excess of those for which they are designed, and any extra wear and tear due to increasing the speeds will be debited to electrical driving.

The tendency of the discussion was to show that the saving in power with variable speed control was a small matter compared with the increased turnover, which ranges from 25 to 100 per cent. Where the total fuel bill is only from 3 to 5 per cent. of the cost of the product, a 20 per cent. increase in output amounts to a greater saving than if the whole fuel bill had been saved.

* See abstract of paper and discussion, ELECTRICAL REVIEW, January 16th, pp. 119 and 120.

HIGH-SPEED TREMBLER FOR INDUCTION COILS.

THE system principally used for igniting the explosive charge in the internal-combustion engines of automobiles is that of a spark furnished by means of small accumulators and an induction coil; the method is not, however, altogether without its drawbacks. One of the principal of these has so far been the difficulty of obtaining a coil which would ensure perfect ignition in high-speed motors, most of the coils hitherto employed being incapable of giving a satisfactory spark without continual adjustment at speeds exceeding

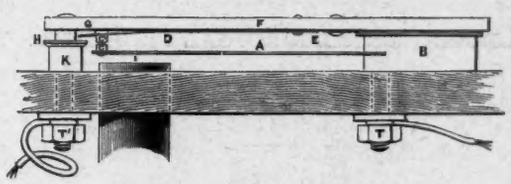


FIG. 1.—THE ARNOUX-GUERRE HIGH-SPEED TREMBLER.

1,000 revolutions per minute, at which the bulk of motor-car engines run. Messrs. Arnoux and Guerre, two French electrical experts, who have devoted much attention to the question of induction coils for petrol motor-cars, have found that the frequency of vibration of the form of trembler usually employed is between 162 and 172 semi-vibrations per second. This corresponds with 80 to 86 ruptures of the circuit, from which it may be figured that the time necessary for the ordinary trembler to establish and break the primary circuit is at least $\frac{1}{80}$ second. Thus, as the duration of the contact established and broken by the cam is greater or less than this period, the induction coil will give a spark or will not give one at all. It is the latter which happens in the case of motors running at greater speeds than 1,000 to 1,200 revolutions per minute, the period during which the circuit is completed being too brief to give a spark.

Having determined this point, the two experts named set to work to get over the difficulty, and the trembler illustrated herewith is the result of their labours. It is designed to permit practically unlimited speed of the motor, and yet give perfect sparking under every condition. The new trembler, with a 4-volt current, makes

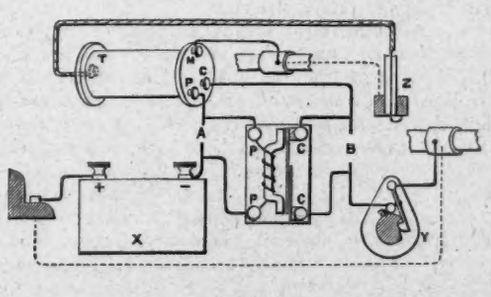


FIG. 2.—DIAGRAM OF CONNECTIONS OF AUTO-TREMBLER.

436 interruptions per minute, that is to say, five sparks in the same time as the ordinary type gives one, enabling the makers, Messrs. Chauvin & Arnoux, of Paris, to claim that a motor may be run at speeds as high as 5,000 revolutions per minute without the ignition failing. Furthermore, it is claimed that the increased speed of vibration results in a spark of great energy, and considerably increases the capacity of the coil. Referring to fig. 1, the trembler proper consists merely of a highly magnetised steel blade, A, fixed at one end in a block of insulating material, B. The upper bar, F, is fixed at both ends to the pillars, K, T, and to its underside is attached a subsidiary trembler, D, carrying at its free end a platinum contact, C'. The downward movement of this trembler is limited by a projection, H, on the pillar, K. The actual trembler blade, A, is also furnished, at its free end, with a platinum contact, C; this blade vibrates in response to the impulses given by the core, which is magnetised and demagnetised as the primary circuit is closed or broken by the contact breaker on the engine. It may here be noted that there is no button of soft iron to add to the inertia of the trembler blade, so that the total number of vibrations per second which may be made is practically unlimited. When the blade, A, is drawn down by the core, I, the upper trembler, D, follows it until

its end comes into contact with the projection, H. A sudden and violent rupture then occurs between the two platinum contacts, C C', owing to the blade, A, being capable of further downward movement than the trembler D. The new trembler can be fitted to existing coils by means of the two nuts and screws shown in the illustrations, thus converting them into high-speed coils, no alteration to the existing core being necessary. It will also be noted that the blades are not fitted with any regulating device, the trembler being permanently adjusted by the makers. In order to get over the difficulties experienced with motors having non-trembler coils, Messrs. Chauvin & Arnoux have introduced a modification of the device described above, which they have termed the "auto-trembler." The arrangement consists of a small primary winding in series with the primary winding of the existing non-trembler coil. Fig. 2 illustrates the method of inserting the "auto-trembler" in the circuit, X being the accumulator, Y the contact maker, Z the sparking plug, T the induction coil, and P C the "auto-trembler." When the circuit is completed at the contact breaker, the trembler comes into action and makes and breaks the circuit as though it were attached to the coil. The auto-trembler is a compact little device, its weight being about 4 ozs.

ELECTRO-METALLURGICAL PROBLEMS.—VI.

(Conclusion.)

By ALEC. A. BEADLE, A.I.E.E., F.C.S.

Iron.

Until quite lately electro-metallurgy has been applied to iron only for its deposition for the protection of electrotype plates. It has been suggested to refine iron in a like manner, adding to the pure product definite proportions of other alloys as required. In this connection it may be interesting to note that, according to Haber, pure iron can be deposited from its sulphate, but that in order to produce a compact film it requires about six weeks to deposit a thickness of 2 mm. Pure iron thus formed, being free from electro-negative impurities, resists rust far better than the ordinary metal, but it contains from 10 to 200 times its volume of hydrogen. According to other investigators, the safe rate of deposition is 0·1 to 0·5 ampere per sq. dcm. of cathode surface. Houllevigne states that carbon can be deposited up to 0·017 per cent., using a steel anode tempered so as to contain its carbon dissolved but not combined; if the anode carbon be combined, the produced iron is richer in carbon. In what form this carbon is conveyed seems uncertain, but it would be idle to deny its possibility without further experiment. Toepffer deposits alloys of iron with nickel, and Küster states that the lower the current density, the larger the proportion of iron.

Iron powder, a most useful reducing agent, can be deposited from its organic salts at suitable current densities.

The smelting of iron and steel in the electric furnace has received much attention of late, and, when carefully considered, it can be seen that the possibility of its development is not remote. Several methods have been put forward, all simply supplying the necessary heat from electrical energy instead of fuel. The application to different ores is a matter of fluxes, as in the ordinary furnace. Sufficient carbon for reducing purposes has, however, to be added to the charge. The best form of furnace has not yet been determined, but constitutes one of the main problems in its development.

The general idea is to replace the hot zone of a furnace by an electric furnace of great power in which the reduction takes place, the reduced metal falling through, or the reduction may be performed in a magnetic field where the richest particles of the ore congregate and bridge the electrodes, losing their magnetic permeability and falling through on becoming heated. It has been stated that in the Conley furnace it is estimated that the cost of steel ingots, including energy, coke, ore, labour, &c., would be $11·85 per ton of metal, the energy being less than a quarter that total amount.

Ruthenberg states that he can melt a ton of iron ore with an expenditure of 500 KW.-hours; this appears to be a good deal lower than that stated to be required by other investigators.

Iron of 99·7 per cent., ferro-manganese, spiegeliesen and ferro-chrome have been satisfactorily produced by Stassano's process, which is an adaptation of the Martin furnace pattern, with basic hearth, to electric smelting.

It is doubtful whether electric smelting will ever take an important place in coal-bearing districts, but in combination with magnetic concentration in localities where water power is available and fuel scarce, it may have a brighter future.

Tin.

Although the production of metallic tin from tinstone (oxide) is a complicated branch of metallurgy, yet no serious attempts have ever been made to introduce an electrical process. Three great difficulties stand in the way: It is unsuitable for fused electrolysis, as no suitable salt can be obtained, neither can it be satisfactorily reduced in the electric furnace, as its power of volatilising at a temperature apparently below its boiling point (about 1,500° C.) makes it impossible to produce it in a fused condition without great loss. The third difficulty is that, although it can be brought into solution from tinstone by means of sodium bisulphate and several other solvents, yet from none of these solutions can it be deposited to any practical thickness in a coherent form, except by the expensive mandrel method. Refining of metallic tin is, therefore, in much the same position. The timeworn problem of recovery from tinned iron scrap has for its basis a good profit, based on sound enough reasoning, but meets with several difficulties in practice besides that of the difficulty of depositing in coherent plates. If the scrap is used as anode, only the surface tin (which amounts to only 1 per cent. of the weight of the scrap on well-tinned iron) is removed, and that which has alloyed with the iron is sufficient to prevent the latter from being hammered up into a coherent mass. Moreover, the scrap, which is not by any means so plentiful and cheap as generally supposed, is fearfully bulky, and awkward to deal with.

Tungsten.

The chief applications of tungsten are those in which it is required as salts and not in metallic form; tungstate of soda is produced from wolfram in the separation of this mineral from tinstone, with which it often occurs. Its only important application in metallic form is in the alloy with steel as tungsten-steel, which generally contains about 6 or 7 per cent. of metallic tungsten added to the steel in the form of "ferro-tungsten," an alloy with iron consisting of about 50 per cent. of each metal. The production of this alloy is then the most important problem. Metallic tungsten can be reduced with carbon from artificially-made tungstic acid either to a powder in an ordinary furnace or fused together in an electric furnace; it may be produced from scheelite (tungstate of lime), or from any salt capable of calcining to the oxide. It can also be reduced by powdered aluminium or magnesium. The tungsten can be alloyed with the original pig-iron by introducing wolfram into the charge, and it has been proposed to deposit it electrically into the molten iron used as cathode from the fused slag of the blast furnace, but the practicability as well as the advantages of this seem doubtful.

Nickel and Cobalt.

The most complex metallurgy of nickel and cobalt is still further complicated by the extreme difficulty in their subsequent separation from each other. They almost invariably occur associated with one another, and often with sulphides of copper, iron, &c., and where found in quantities of above 2 or 3 per cent. are often worth working. A matte is now generally first produced containing also copper, which is subsequently separated into nickel-cobalt and copper mattes by heating with soda sulphate and coal.

These processes are expensive, lengthy, and, where much cobalt is present, they are unsatisfactory, and for this reason complicated wet processes are often resorted to. The well-known Mond-Carbenyl process has stepped in opportunely for the separation of these two metals, but there is still room for a process which would simply treat such a matte as the following, which may be taken as typical: 20—25 per cent. copper, 18—20 per cent. nickel, 20—30 per cent. iron, together with sulphur and other impurities, and also cobalt, gold, and silver.

Frasch has proposed to refine these mattes in ammonium salts or a solution capable of dissolving the hydroxides of the metals. Toepffer, as above stated, has shown that iron is deposited along with nickel at fairly high current

densities, and Küster, that iron almost free from nickel would be deposited at very low current densities, contrary to what would be expected from the voltages of decomposition. In connection with the refining of these metals it may be interesting to note that, according to Foerster, an impure nickel containing 0·4 per cent. C, 0·02 per cent. Si, 0·10 per cent. Cu, 0·43 per cent. Fe, 0·14 per cent. Co, and 0·02 per cent. Mn can be refined in a solution of sulphate of nickel, and the resulting metal is free from C, Si, Cu, and Mn, but still contains its iron and cobalt. What is required is a method of fractionally electrolysing a mixed solution of nickel, cobalt, copper, and iron.

Mercury.

The reduction of cinnabar (sulphide) to metallic mercury, is an extremely simple operation, and consists in heating the ore in earthern vessels in a chamber to which air is admitted, the sulphur being oxidised to sulphurous acid, and the metal volatilised, and condensed in a series of small cool chambers. This method is most injurious to those occupied on the works as losses take place, especially on poor ores, which pollute the atmosphere. On this account there is room for an efficient electrolytic process. Mercury can be satisfactorily reduced from its solutions and, moreover, cinnabar is soluble in alkaline sulphides and nitric acid. A process has been devised in which the ore is finely crushed and treated with a strong solution of sodium sulphide containing caustic soda, the resulting solution is then electrolysed in iron vats used as cathodes with sheet steel anodes. The current density is 0·5 to 0·8 ampere per sq. dcm., and the voltage required is 2·0. All the mercury is extracted, and the solution is again ready for acting on more ore. The last point is, perhaps, the most important and most doubtful, because it would be essential to be able to regenerate such a solvent as sodium sulphide in such an out-of-the-way place as a mercury mine.

Mercury ordinarily imported contains zinc, lead and other impurities, and is purified by contact with dilute nitric acid, which dissolves these impurities. W. M. Johnson proposes to electrolyse it in a solution containing 4 per cent. of potassium nitrate and 17 per cent. of nitric acid. He states that 1 volt is necessary, and that the current must be occasionally interrupted to prevent the impurities from going into solution. Zinc, cadmium, copper and lead may thus be separated, and by addition of potassium chloride, the silver may be prevented from depositing. It seems, therefore, that attention might with some advantage be devoted to the electro-metallurgy of mercury.

Antimony.

The only remaining metal of importance with which we have space to deal, is antimony. Its ordinary metallurgy is simple enough, although it sounds somewhat complicated. It is almost exclusively extracted from antimonite (sulphide) which is associated with iron pyrites, galena and a gangue of quartz, schist, barytes, &c., and from which latter it is separated by fusion in perforated crucibles the antimonite melting, and leaving the gangue behind. It is then fused with salt and iron turnings, which reduces the impure antimony, this is then refined by reheating with some original liquated ore which purifies the antimony by simple replacement. The antimonite thus employed is simply added to the charge in the first operation of the next batch.

The antimony is next freed from its sulphur by fusion with sulphide of antimony and potassium carbonate and poured into moulds when a starry surface crystallisation, which is commercially regarded as a proof of its purity, is produced. This surface formation may, therefore, be looked upon as the ultimate aim in refining. The losses in this process approximate to about 10 per cent., which is recovered from the flues as oxide. The ore is sometimes roasted to oxide, and smelted with salt cake and other fluxes.

The above process is described at length, as it seems to be a fused electrolytic process in disguise, the reduction by metallic iron and purification of the crude metal by simple replacement from the fused original ore simply taking the place of fractional electrolysis. Several investigators seem to have failed to obtain either antimony or sulphur by electrolysis of the fused antimonite, but this has probably been due to the production of "fume," so common in the electrolysis of fused salts with solid electrodes before the proper conditions of temperature and current density are fully understood. Commercial antimony necessarily contains most of the gold present in the original ore, sometimes amounting to several ounces of gold per ton of metal; such a fused process might enable the gold to be removed first by fractional electrolysis. Chloride of antimony is too fusible and volatile for fused electrolysis, and in solution produces the unmanageable explosive variety. Antimonite is, however, soluble in solutions of the alkaline sulphides from which it can be deposited without formation of the explosive form, but not in a thick coherent coat. The ordinary process is too simple to allow anything complicated to compete with it, unless it recovers the precious metals, and this seems to be where an electrolytic process, either fused or in solution, would prove advantageous.

THE CHOICE OF ENGINES FOR TRACTION STATIONS.

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

The choice of the type of engines to instal in a moderate-sized traction station is one of the most interesting points which the engineer has to decide. It is to be feared, however, that, in too many cases, the question is settled in accordance with whatever happens to be the fashion at the moment, or else in accordance with some special experience which the engineer may have had. Thus, if he has worked with quick-speed engines only, he may think them correct for all purposes, whilst another, who has been fortunate in running some particularly successful horizontal slow-running engines, will swear by slow speed.

In the following notes the writer proposes to draw attention to the great importance of simplicity of design, and incidentally to put in a plea for the ordinary tandem-compound single-crank engine and for the employment of high superheat.

The single-crank type has had some hard things said of it, but it has done splendid work, and one of the most significant features of the Paris Exhibition was the number of single-crank engines which were in evidence.

The unequal turning effort given by the single crank has been objected to, and yet we find such engines driving alternators most successfully in parallel, as, for example, at Frankfort.

After all, this question of even turning is only a matter of having a sufficiently heavy fly-wheel, and it is surely cheaper to add fly-wheel weight at £12 or £14 a ton than to have an extra line of parts, with all the extra details of valve gears, glands, &c., requiring attention.

As a matter of fact, if a single crank is not admissible, makers ought to jump at once to the three cranks, for two cranks at right angles, by giving two peaks to the turning moment diagram, are more difficult to deal with.

The single-crank engine is preferable to the cross-compound two-crank for dynamo driving, because the dynamo is so much more accessible, the crankshaft being simply extended, and its end carried by an outboard bearing. In the cross-compound, on the other hand, with the dynamo placed on the crankshaft between the two cylinders, the armature cannot be removed without dismantling the engine and taking off one of the cranks.

It may be mentioned that when working on a variable load, there is a distinct disadvantage in having a multiplication of cylinders with their various connecting pipes and receivers. Such cylinders, &c., carry a large amount of steam which is out of reach of the governors in the event of any sudden variation of load. This, in fact, is an additional reason for placing the two cylinders of a compound engine in tandem, that is to say, in close proximity.

Coming now to the question of superheat, it appears to the writer that if superheat is to be used at all it should be at a high temperature, so as to get all the benefit possible from it. In any case the engine must have certain special

details and arrangements for lubrication, &c., and it will not cost any more to provide in this direction for steam having 340° F. of superheat than it does for only 120° F.

There is this to be said, that with high superheat Corliss valves are not possible, and it is, therefore, necessary to have drop or double-beat valves. There is, however, no disadvantage in this, for the Sulzer engine, which may be reckoned as one of the best on the market, has always been fitted with double-beat valves. As a matter of fact, the writer considers they are far preferable, because they enable the engine to run at a higher speed, say, 140 revolutions, as against 100 revolutions with Corliss valves.

When comparing two given engines, it is not enough to look simply at their first cost; one must consider what saving in coal is given by the engine having the lowest consumption. Thus, of two tandem compound engines of similar type and, say, 300 I.H.P., the steam consumption when working with ordinary saturated steam at 160 lbs. pressure and condensing, will be about 14 lbs. per I.H.P.-hour. Working with steam superheated to, say, 700° F., the consumption would be only 9 lbs. per I.H.P.-hour. (This result was actually obtained on some Schmidt engines at the British Xylonite Works, of which the writer has knowledge, the cylinders being 15 and 24 × 28 in., and the speed 140 revolutions per minute.)

A 300-I.H.P. engine will easily drive a 200-KW. generator, and a difference in steam consumption of 5 lbs. per I.H.P.-hour gives a difference of 8 lbs. per KW.-hour. If we now assume that the full load of 200 KW. is given for 365 days, 14 hours per day, and that the coal costs 14s. a ton, and evaporates 9 lbs. of water per lb. of coal, we arrive at the following equation giving the value of the coal saved per annum:—

$$\frac{200 \text{ KW.} \times 8 \text{ lbs.} \times 14 \text{ hrs.} \times 365 \times 14\text{s.}}{9 \text{ lbs.} \times 2{,}240 \times 20\text{s.}} = £280.$$

The externally fired superheater will burn about one-tenth of the coal used in the boiler, so that this reduces the figure to about £250.

This is a very handsome annual saving, and capitalised at 5 per cent. represents a capital value of £5,000, or more than enough to buy two engines such as we have been considering.

OPPOSITION TO TRAMWAY SCHEMES.

[FROM A LEGAL CORRESPONDENT.]

The time is now approaching when the Private Bill Committees of Parliament will be called upon to consider numerous schemes for the expansion and inauguration of electric tramways. The almost universal adoption of electricity as a means of traction has led to the joining up of towns one with another by means of tramways along the roads. The tramway is no longer devoted entirely to the needs of those who live in urban districts, but has assumed the important *rôle* of dealing with the through traffic from one town to another.

Perhaps the most formidable opponents of electric tramway schemes are to be found amongst the persons whose property abuts upon the suggested route. Although many frontagers are glad to have a cheap and satisfactory means of locomotion brought to their very doors, there are others who regard an electric tramway as an institution which may have the effect of depreciating the value of private residential property. This depreciation may be brought about by the fact that an electric tramway tends to drive away the higher class residents. Other frontagers may object to the laying of rails in their street, because of the obstruction which trams occasion to ordinary vehicular traffic, and of the difficulties which arise when the street is so narrow that vans and wagons cannot be allowed to remain outside a warehouse when the trams are running.

In view of the fact that the proceedings of Private Bill Committees are not easily accessible, it is difficult to arrive at the general principles which lead a committee to decide whether the opposition of frontagers shall or shall not prove fatal to the establishment of a tramway along a particular road. It may be that the benefits which the establishment of a line are likely to confer upon the neighbourhood, largely outweigh the disadvantages of which the frontagers complain; indeed, it is an assumption of this kind which probably leads to the failure of much opposition on the part of frontagers.

As a general rule, so long as the rails are placed at a suitable distance from the kerb, the inclination of the Private Bill Committees seems to be to disregard the opposition of frontagers, although an opportunity of stating their grievances is afforded to them.

In the case of a tramway, a provisional order of the Board of Trade requires confirmation by Parliament. As a rule the confirmatory Act relates to a number of orders and goes through without objection. But if a petition is presented against the order, the Bill (so far as it relates to the order petitioned against) may be referred to a Select Committee, and be dealt with as in the case of an opposed Bill for a special Act.

These petitions are occasionally presented by frontagers. All frontagers are entitled to notice of the proposed tramway scheme. Thus Rule IX. of the Board of Trade Tramway Rules provides that on or before the 15th day of December immediately preceding the application for a provisional order, notice in writing must be given to the owners or reputed owners, lessees or reputed lessees, and occupiers of all houses, shops, or warehouses abutting upon any part of any street or road where, for a distance of 30 ft. or upwards, it is proposed that a less space than 9 ft. 6 in. shall intervene between the outside of the footpath on either side of the road and the nearest rail of the tramway. Subsequently, and on or before December 23rd, the promoters must deposit at the Board of Trade a list of (*inter alios*) the frontagers affected by the proposed order.

Unless the road is of sufficient width, opposition by such persons may prove absolutely fatal to a provisional order. It is provided by Sec. 9 of the Tramways Act, 1870, that every tramway in a town which is authorised by provisional order must be constructed and maintained as nearly as possible in the middle of the road. The Section also provides that no tramway shall be authorised by any provisional order to be so laid that, for a distance of 30 ft. or upwards a less space than 9 ft. 6 in. shall intervene between the outside of the footpath on either side of the road and the nearest rail of the tramway, if one-third of the owners or one-third of the occupiers of the houses, shops or warehouses abutting upon the part of the road where such less space shall intervene as aforesaid shall in the prescribed manner and at the prescribed time express their dissent from any tramway being so laid. There is no definition of the term "town" as used in this section, but it is probable that it applies to any place which is usually regarded as a town in the popular sense.

It is to be observed, however, that the foregoing provision, which enables the frontagers to put an absolute veto on the laying of a tramway only applies on application for a Provisional Order. It is competent for a Private Bill Committee to grant an Act which will enable a tramway company to lay their line in a narrow street. As a general rule, however, close regard is had to the "9 ft. 6 in. rule," and a clause to this effect is often inserted in private Bills. Sec. 91 (3) of the South Lancashire Tramways Act, 1900, affords an illustration of the kind of clause which is inserted to ensure that there shall be sufficient accommodation for vehicular traffic between the tram rails and the footway. It is there provided that "The company in laying their rails along such main roads shall, in all cases, save where a certificate of the county surveyor shall be granted as aforesaid, cause the same to be laid, placed and maintained in such position as to allow a space of 9 ft. 6 in. between the outer edge of the kerb and the centre of the nearest rail on the other side, so as to allow room for carts laden with hay and straw and other overhanging loads to pass freely on one side of such track except at crossing and passing places."

In addition to the rights conferred upon them to intervene when the company is threatening to infringe the "9 ft. 6 in. rule," frontagers have other powers of opposition. Thus Sec. 14 of the Tramway Act, 1870, provides that a petitioner against a Bill to confirm a provisional

order may appear and oppose as in the case of a Bill for a special Act.

It is clearly established that frontagers have what is called a *locus standi* to oppose a Bill. We have seen that such persons are entitled, with certain limitations, to receive notice of applications for provisional orders in accordance with certain rules. They are entitled to a *locus standi* to oppose such clauses as may effect their premises. Various other persons sometimes claim a *locus standi* as frontagers, although their premises do not adjoin the route or satisfy the Board of Trade rule.

In the case of the Brentford and District Tramways Bill, ex p. Thomas Twining and Others (R. & M., 8), the petitioners who had been served with notices, were the occupiers of nine houses, situated on both sides of a road, within a length of 750 yds., along which road it was proposed by the Bill to lay a tramway. The road along which their houses were situated formed the continuation of an urban street, from which they were separated by a railway bridge. They opposed the construction of the proposed tramway as being "frontagers on a street" within the meaning of the Act. It was decided that inasmuch as the road upon which the petitioners' houses were situated, was the tailing out of an admitted street, they were entitled to a *locus standi*.

Again in the case of the North Metropolitan Tramways Bill, ex p. Robert Hunter (Rickards & M., 122), the Bill authorised the construction of a tramway along Commercial Street, upon which Spitalfields Market abutted at one side. The petitioner was a lessee of the market for a term of 84 years, and as such claimed to be heard in opposition to the Bill on the ground that the tramway would render the carrying on of the business of the market a matter of great difficulty. It was held without deciding whether the petitioner was entitled to be heard as an owner or occupier, that his interests, being of a special and exceptional kind, were so affected by the Bill as to entitle him to be heard against it.

In the same Bill (Rickards & M., 125) a *locus standi* to oppose was also conceded to the owners of certain mews which opened on to the road.

Again, to quote a still more recent case, the South-Eastern Railway were held entitled to oppose the London County Council (Tramways and Street Widenings) Bill of 1901 (2 S. and A., 57), on the ground that access to their warehouses would be interfered with by the construction of tramways.

It has been held, however, that the opposition of frontagers must be confined to their grievances as frontagers; thus in the London Council (Tramways and Street Widenings) Bill of 1901 certain frontagers sought a *locus standi* to oppose upon the ground that they were frontagers. They also sought leave to go into the general question of the need of the tramways in the district. It was decided by the Committee that the frontagers could not be heard upon the latter ground.

Although it is difficult to ascertain, by direct means, the actual effect of the opposition to a tramway scheme, much may be gathered from a consideration of the protective and other clauses which are sometimes inserted. Local authorities, for instance, who are bound to have regard for the traffic in a district sometimes appear in their capacity as highway authority, in order to ensure that proper regulations for the management of the traffic shall be observed. Thus in the West Cumberland Electric Tramways Act, 1901 (Sec. 91), it was provided that "the carriages used on the tramways shall not be allowed to remain standing in the streets of any urban district so as to cause obstruction for a longer time than may be necessarily required for the purpose of taking up and setting down passengers or goods, and if necessary for complying with the provisions of this section, the company shall, subject to the provisions of this Act, provide proper and suitable places at the termination of any tramways for the accommodation of carriages."

Heavy penalties are sometimes incurred by tramway companies who tolerate the system of promiscuous stopping and starting. To prevent this, the following clause was inserted in the London United Tramways Act, 1900, at the instance of the Acton Urban District Council:—"The company shall not on Tramway No. 9 cause or permit any of their cars travelling over the said tramway to be stopped for the purpose of picking up or putting down passengers or goods at the crossing opposite the Market Place and Church Road, in the district of the Acton Council; and if any car shall be stopped for such purpose at the said crossing, the company shall forfeit and pay to the Acton Council a sum not exceeding £5 for every such stoppage, and such sum shall be recoverable and payable to the Council, and shall be a penalty within the meaning of Sec. 56 of the Tramways Act, 1870."

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Mopes" writes:—"Might we ask your opinion on the following points:—

"(*a*) We recently carried out an installation at a large house which lies between two roads, the stables being approached from the back of these, and so separated from the house by the grounds. When we applied for current we told the local authority, who supply electricity in the district, that we should ultimately require a separate supply from the back for these stables and they agreed to this, but, unfortunately, only verbally. We have now wired the stables, and they inform us that they can only put in the second supply upon our paying all expenses. Had we known this we could have run it from the house in the first instance. The point is, are they entitled to refuse to give the supply desired? We may say that mains run along both roads. A separate gas supply was put in, also water, and we should have thought it would have been to their advantage to make trifling concessions of this sort to consumers, but wonderful are the ways of the municipal engineer.

"(*b*) The same Council state in their wiring rules that if above a certain number of lights are installed, the installation must be divided into two entirely separate circuits. After we had done this, they made us alter our wiring so as to suit a three-wire meter. Were they entitled to do this? We have reason to doubt the accuracy of this meter, and should also like to know if our customers cannot demand two two-wire meters instead."

*** With regard to (*a*) it would seem that upon the facts stated the Council in question are bound to furnish the lead wires to the stables. Sec. 27 of the schedule to the Electric Lighting Clauses Act, 1899, provides that undertakers shall upon being required to do so by the owner or occupier of any premises situate within 50 yards from any distributing main of the undertakers in which they are for the time being required to maintain, or are maintaining, a supply of energy for the purposes of general supply to private consumers under the special order of the Board of Trade regulations, give, and continue to give, a supply of energy for those premises in accordance with the provisions of the special order and of the said regulations, and they shall furnish and lay any electric lines that may be necessary for the purpose of supplying the maximum power with which any such owner or occupier is entitled to be supplied under the special order subject to the conditions following. Here follow certain conditions by which the undertakers may call upon a prospective consumer to defray the cost of so much of any electric wire which may have to be laid on his premises, and of so much of any electric lines as it may be necessary to lay for a greater distance than 60 ft. from any distributing main of the undertakers. Assuming that "Mopes" is prepared to comply with these conditions, it is impossible to conceive any right on the part of the undertakers in his district to charge him with the entire cost of connecting up the stables with the street mains.

The foregoing opinion is based upon the assumption that the Council in question supply electricity in accordance with the Electric Lighting (Clauses) Act, 1899, or some similar enactment.

With reference to the second point (*b*) upon which advice is sought, this presents somewhat greater difficulty. It is the duty of the undertakers to supply meters, subject to the payment of a reasonable sum by the consumer. (Sec. 58, Electric Lighting Clauses Act, 1899.) If, in these circumstances, the undertakers suddenly elect to change the type of meter used, it would seem that (in the absence of any express authority on the point), they should defray any cost incurred by the consumer in carrying out the alteration.

For Gardeners.—Many of our readers find considerable relief from the stress of business in the very fascinating occupation of gardening. "One and All Gardening" is a cheap little annual for such men, and its 1903 edition, with a first issue of 80,000 copies, will be found to contain many an interesting wrinkle. It is edited by Mr. E. O. Greening, and is published by the Agricultural and Horticultural Association, Ltd., of Long Acre, W.C., at the low price of 2d. per copy.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

2,988. "Improvements in or relating to electricity meters." THE ELECTRIC AND ORDNANCE ACCESSORIES Co., LTD. February 9th.

2,993. "Improvements in electrical influence machines." A. ECKSTEIN and H. J. COATES. February 9th.

2,994. "Improvements in incandescent electric lamps." S. HORVATH and J. H. WHITFIELD. February 9th.

3,010 "Improvements in variable electrical resistances." A. H. MAYES. February 9th.

3,042. "Improvements relating to electrical conduit systems for tramways and railways." F. B. ASPINALL and J. D. DALLAS. February 9th.

3,056. "Improvements in electric lamps." J. B. B. BURKE. February 9th.

3,072. "Improvements in telephone apparatus." R. B. RANSFORD. (The Kellogg Switchboard and Supply Co., United States.) February 9th. (Complete.)

3,073. "Improvements in telephone apparatus." R. B. RANSFORD. (The Kellogg Switchboard and Supply Co., United States.) February 9th. (Complete.)

3,074. "Improvements in telephone apparatus." R. B. RANSFORD. (The Kellogg Switchboard and Supply Co., United States.) February 9th. (Complete.)

3,078. "Improvements in pneumatic railway signalling systems and electro-pneumatic valves therefor." E. C. IRVING and J. P. O'DONNELL. February 9th.

3,080. "Combined telephone transmitter and automatic switch." B. BRANDER. February 10th.

3,102. "New or improved devices for indicating the stopping places of electric tramcars, applicable also for other purposes." I. BOULTON. February 10th.

3,142. "Improvements in and relating to electric fuse switches and the like." J. J. STOCKALL, Jun. February 10th.

3,155. "Improvements relating to the locking of incandescent electric lamps in their holders." J. C. TAYLOR. February 10th.

3,158. "Improvements in apparatus for making coils for electrical apparatus." E. A. CAROLAN. (The General Electric Co., United States.) February 10th.

3,164. "Improvements in high tension switchboards." E. PARRY. February 10th.

3,167. "Improvements in electric rail bonds." W. E. OAKLEY. February 10th. (Complete.)

3,170. "Improvements in and relating to electric brakes for wheels." R. W. JAMES. (The Algonquin Electric Brake Co., United States.) February 10th. (Complete.)

3,172. "Improvements in coin-feed apparatus for supplying a current of electricity to persons using it, after the insertion of a predetermined coin." F. H. URRY and W. HAYDON. February 10th. (Complete.)

3,183. "Improvements in telegraphy," R. B. RANSFORD. (The Delany Foreign Co., United States.) February 10th. (Complete.)

3,195. "Improvements in electrical measuring and indicating instruments." E. DU BOIS. February 10th.

3,198. "Improvements in or connected with arc lamps." J. A. RIGNON. February 10th. (Complete.)

3,199. "Improvements in electrical methods for transmitting power." O. D. LUCAS. February 10th.

3,204. "Improvements in and connected with trolleys and trolley poles for electrically-propelled vehicles and the like." A. L. TYERMAN. February 10th.

3,219. "A new or improved device for preventing accidents from overhead trolley wires when broken." J. TITLEY. February 11th.

3,244. "Improvements in electrical ignition apparatus applicable to internal combustion engines." A. ECKSTEIN and H. J. COATES. February 11th.

3,274. "An improved electricity meter." THEILER & Co. (Date applied for under Patents Act, 1901, February 15th, 1902, being date of application in Switzerland.) February 11th. (Complete.)

3,281. "Electric controlling apparatus for lifts and other automatic transport contrivances." H. HEIN and K. MÖLLER-HOLST. February 11th. (Complete.)

3,319. "Improvements in apparatus for regulating and directing electric currents in connection with dynamo-electric machines." J. ATKINSON. February 12th.

3,357. "Improvements relating to telegraphic apparatus." A. MORETTI. February 12th.

3,395. "Improvements in switch for overhead electric tramcars." T. GREGORY. February 13th.

3,396. "Improvements in electrotype blocks." J. W. CORNELIUS. (Date applied for under Patents Act, 1901, February 13th, 1902, being date of application in United States.) February 13th. (Complete.)

3,420. "Improvements in or relating to chemical rectifiers for converting an alternating electric current into a direct current." A. CHAPLIN. February 13th.

3,425. "Improvements in means for controlling electric circuits." H. LEITNER and R. N. LUCAS. February 13th.

3,444. "Improvements in electric gas or vapour lamps." F. W. LE TALL. (Cooper-Hewitt Electric Co., United States.) February 13th.

3,458. "Improvements in electric ignition devices for oil or gas engines." H. BEVIS and A. E. BENNETT. February 13th.

3,469. "Improvements in and connected with telephone intercommunication systems." I. B. BIRNBAUM. (The Telephon-Fabrik Actiengesellschaft, Germany.) February 13th.

3,509. "Improvements in or relating to electrical lampholders." G. SPERRYN and W. H. WOOD. February 14th.

3,512. "Electrically-illuminated bar casks." T. T. POWER. February 14th.

3,521. "Pneumatic control electric switch." A. E. FARROW and W. BLENHEIM. February 14th.

3,522. "Improvements in or relating to induction coils used in connection with the electric ignition systems of internal combustion engines." C. HALL and F. H. HALL. February 14th.

3,526. "Improvements in electric dynamos, motor, and the like." F. D. GARARD. February 14th.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

17,618. "Improvements in and relating to current distributing and collecting devices for use in connection with electric railways, tramways and cranes, and for like purposes." J. T. Knowles. (E. A. Stierlin.) Dated September 3rd, 1901.

17,621. "Improvements in or relating to apparatus for hauling electric cables." H. B. Grinnell. Dated September 3rd, 1901.

17,641. "Improvements in dynamo-electric machinery." H. M. Hobart. Dated September 3rd, 1901.

17,656. "Improvements in the manufacture of glass by electricity." C. G. Redfern. (Soc. Anon. de l'Industrie Verriere et ses derives.) Dated September 3rd, 1901.

17,658. "Improvements in or relating to electric meters." F. Saldana. Dated September 3rd, 1901.

17,664. "Improvements in or relating to electric transformers, exciter coils, and field magnets." F. Pichler. Dated September 3rd, 1901.

17,711. "Improvements relating to the transmission of telegraphic and telephonic signals." L. Maiche. Dated September 4th, 1901.

17,801. "Improvements in transmitting telegraph keys." C. Shirley and J. F. Skirrow. Dated September 5th, 1901. (Date applied for under Sec. 103 of Patents Act, 1883, August 6th.)

17,852. "Improvements in heat-producing device for the smelting of ores and the fusing of minerals in furnaces." S. F. Pierce. Dated September 6th, 1901.

17,877. "Improvements in and relating to trolley wires for electric tramways and the like." E. G. Thomas. Dated September 6th, 1901.

18,023. "Improvements in electric storage batteries." L. Bristol. Dated September 9th, 1901.

18,027. "Improvements in dynamo-electric machines and motors." G. Guy. Dated September 9th, 1901.

18,110. "Improvements in connection with electrically-operated cranes and other electrically-operated machines or vehicles." J. Brown & Co., T. J. Tresidder and D. G. Jones. Dated September 10th, 1901.

18,155. "Improvements in regulating electric currents and the electro-magnetic regulators therefor." Otis Elevator Co. (Otis Elevator Co., New York.) Dated September 11th, 1901.

18,179. "Improvements in electric cables." J. H. West. (Patent refused.) Dated September 11th, 1901.

18,180. "Improvements in the manufacture of electric cables." J. H. West. Dated September 11th, 1901.

18,256. "Improvements in electrical batteries." M. J. B. A. Colletas. Dated September 12th, 1901. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, February 12th.)

18,273. "A vehicle to be used in electric traction on railways." G. Cawley. Dated September 13th, 1901.

18,329. "Improvements in electric circuit-breakers." British Thomson-Houston Co. (E. M. Hewlett.) Dated September 13th, 1901.

18,330. "Improvements in electric motor control systems." British Thomson-Houston Co. (F. E. Case.) Dated September 13th, 1901.

18,331. "Improvements in systems of electric motor control for electric railways or trams." F. E. Case. Dated September 13th, 1901.

18,332. "Improvements in electric rheostats." British Thomson-Houston Co. (F. E. Case.) Dated September 13th, 1901.

18,346. "Improvements in recording apparatus for electrical currents." R. Ziegenberg. Dated September 13th, 1901.

18,428. "Improvements in systems of electric motor control." British Thomson-Houston Co. (P. Farnsworth.) Dated September 14th, 1901.

18,502. "Improvements in electric arc lamps." (R. Froment.) Dated September 16th, 1901.

18,505. "Improvements in central station apparatus of telephonic installations with parallel-branched subscribers' jacks." U. D. Abel. (Siemens & Halske Aktiengesellschaft.) September 16th, 1901.

18,530. "Improvements in electric dynamos and motors." W. R. Marshall. Dated September 17th, 1901.

18,569. "Improvements in incandescence electric lamps." J. R. Quain. Dated September 17th, 1901.

18,597. "Improvements in electric regulating apparatus." W. J. Clark. (J. B. Foote.) Dated September 17th, 1901.

18,598. "Improvements in alternating current electric meters." British Thomson-Houston Co. (E. Thomson.) Dated September 17th, 1901.

18,610. "Improvements relating to electric telegraphy." A. Muirhead. Dated September 17th, 1901.

18,652. "Improved means applicable for use in breaking electric arcs." T. von Zweigbergk. Dated September 18th, 1901.

18,691. "Improvements in and relating to electric switches." A. D. Smith. Dated September 19th, 1901.

18,782. "Improvements in contacts for electric glow lamps." Electric Lighting Boards, Ltd. (A. Lefebre.) Dated September 19th, 1901.

18,797. "Improvements in trolley-line switches, and the methods of operating the same." P. H. Dawe. Dated September 20th, 1901.

18,814. "Improvements in connection with the electric actuation of toys." W. Dunn. Dated September 20th, 1901.

18,831. "Improvements in electric telegraphs for use on board ship and for other purposes." Evershed & Vignoles and S. Evershed. Dated September 20th, 1901.

18,879. "Improvements in or relating to collectors for electric tramways and the like." A. N. Connett. Dated September 21st, 1901.

18,895. "Improvements in and relating to electric switches." S. Z. de Ferranti. Dated September 21st, 1901.

18,898. "Improvements in electric current controllers." T. von Zweigbergk. Dated September 21st, 1901.

18,947. "Improvements in electric current controllers." T. von Zweigbergk. Dated September 23rd, 1901.

19,057. "Improvements in casings for electric arc lamps." H. H. Lake. (Lea Electric Manufacturing Co.) Dated September 24th, 1901.

19,062. "Improvements in or relating to conduits for electric railways and the like." A. N. Cornett. Dated September 24th, 1901.

19,068. "Improved process for electrolytically precipitating simultaneously amalgamating metals." W. S. Henneberg. Dated September 24th, 1901.

19,136. "Cover for electric cells." C. Vogt. Dated September 25th, 1901.

19,170. "Improved means for guarding ships against collision and of guiding them in dangerous waters." A. N. Hoyland. Dated September 25th, 1901.

19,224. "Improvements in electricity meters." British Thomson-Houston Co. and F. Holden. Dated September 26th, 1901.

19,225. "Improvements in incandescent electric lamps." British Thomson-Houston Co. (W. J. Howell.) Dated September 26th, 1901.

19,226. "Improvements in systems of electric distribution." British Thomson-Houston Co. (H. Edwards.) Dated September 26th, 1901.

19,227. "Improvements in systems of electric distribution." British Thomson-Houston Co. (H. F. T. Erben.) Dated September 26th, 1901.

19,230. "Improvements in electric arc lamps." British Thomson-Houston Co. (W. C. Fish.) Dated September 26th, 1901.

19,231. "Improvements in automatic electric circuit-breakers." British Thomson-Houston Co. (C. D. Haskins.) Dated September 26th, 1901.

19,245. "Improvements relating to dynamo-electric machines." C. P. E. Schneider. Dated September 26th, 1901.

19,314. "Improved electric coupling." E. K. Murphy. Dated September 27th, 1901.

19,377. "Improved means of fixing carbons for dynamos and motors." W. Hartnell. Dated September 28th, 1901.

19,393. "Improvements in or connected with electric motors." H. Fomm, K. Fomm, and G. Fomm. Dated September 28th, 1901.

19,440. "Automatic cut-out device for overhead trolley wires as used for electrical traction." W. Halliwell. Dated September 30th, 1901.

19,462. "Improvements in electro-magnets." E. Ducretet. Dated September 30th, 1901.